MACHINERY

Volume 45 NEW YORK, FEBRUARY, 1939 Number 6

Building Steam Turbines to Exacting Requirements

Methods Used in the Building of Large Steam Turbines at the South Philadelphia Works of the Westinghouse Electric and Mfg. Co.

By CHARLES O. HERB

STEAM turbine drives, either geared or electric, are standard propulsion equipment for ships whenever high speed and quick manoeuverability are desired. Drives of these types are, therefore, widely used both in naval vessels and in merchant ships. It is their steam turbines that enable cruisers to obtain speeds up to thirty-five knots, and destroyers up to forty knots. The faster ocean liners are also driven by turbines, the *Queen Mary*, for example, having a turbine geared drive and the *Normandie* a turbine electric drive. Turbine drives are used on many freighters and oil tankers, as well.

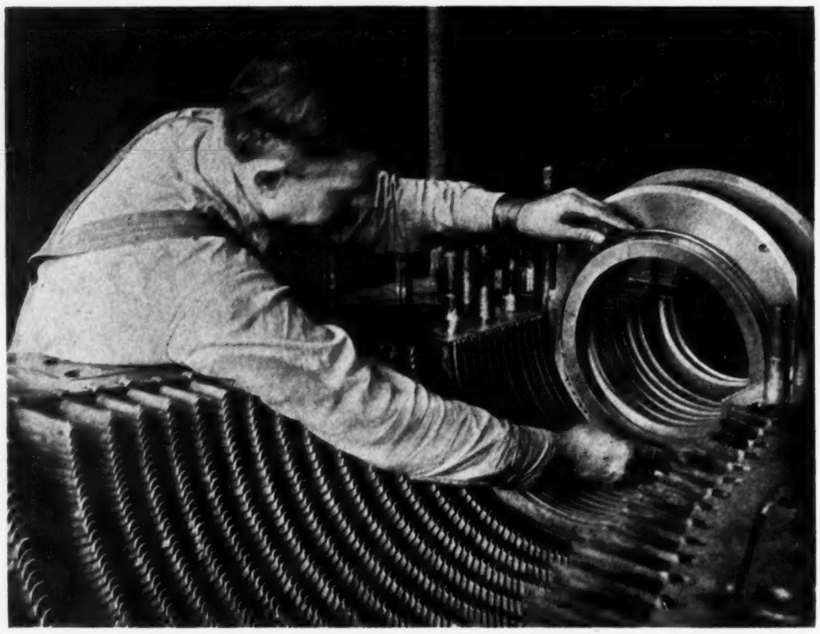


Fig. 1. The Manufacture of Steam Turbines Requires Workmanship of the Highest Order to Insure Satisfactory Performance at Blade Tip Speeds as High as 1000 Feet a Second

Twenty years ago, a steam pressure of 175 pounds per square inch was considered high in turbine operation. Today, pressures as great as 650 pounds per square inch are common aboard ship, and pressures as high as 1200 pounds per square inch are employed in land turbines. The high-pressure turbine of a marine drive may run at as high a speed as 6000 R.P.M., and even the low-pressure turbine can run as fast as 5000 R.P.M.

Modern ships are, of course, completely dependent upon their mechanical drives. For this reason, marine turbine manufacturers follow the precept that "nothing is too good" for equipment that must run day in and day out to drive vessels without interruption across thousands of miles of sea. The best of materials and the finest of workmanship are constant objectives.

The Westinghouse Electric & Mfg. Co. was one of the pioneers in the adoption of the steam turbine for marine use. Up to the present time, this concern has produced marine turbine equipment amounting to a total of over 3,000,000 H.P. Twenty years ago, a large plant was built on the Delaware River near Philadelphia for the sole purpose of producing Westinghouse turbines for ships. Typical manufacturing operations in this plant will be described in the following.

In some respects, the blades are the most vital parts of a turbine, because they must transmit the energy of the steam to the rotor. All the turbine blades are made from corrosion-resistant steel, some blades being forged, some milled from one solid piece, and others built up of two pieces that are brazed together.

Fig. 2. Preliminary Step in Forging a Low-pressure Turbine Blade from a Bar of Non-corrosive Steel

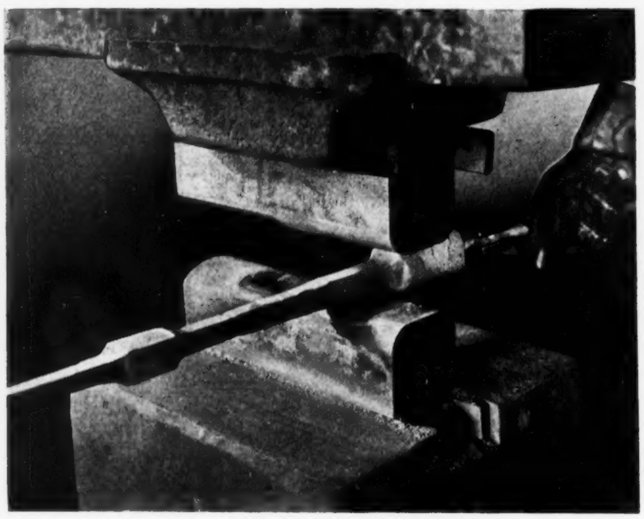
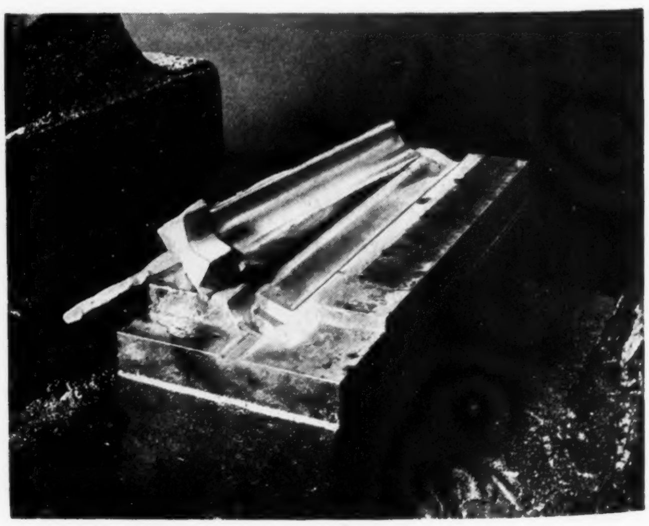
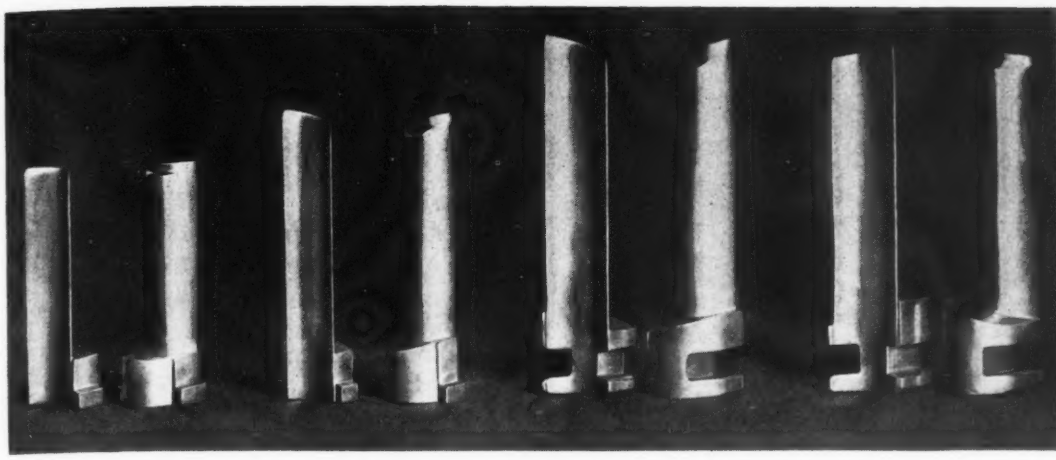


Fig. 3. The One-piece Blade is Formed to Final Shape in from Two to Ten Operations under a Drop-hammer





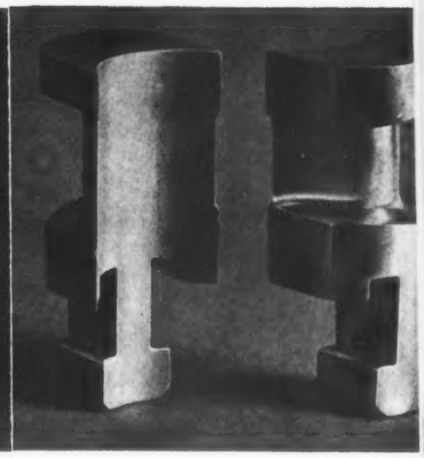


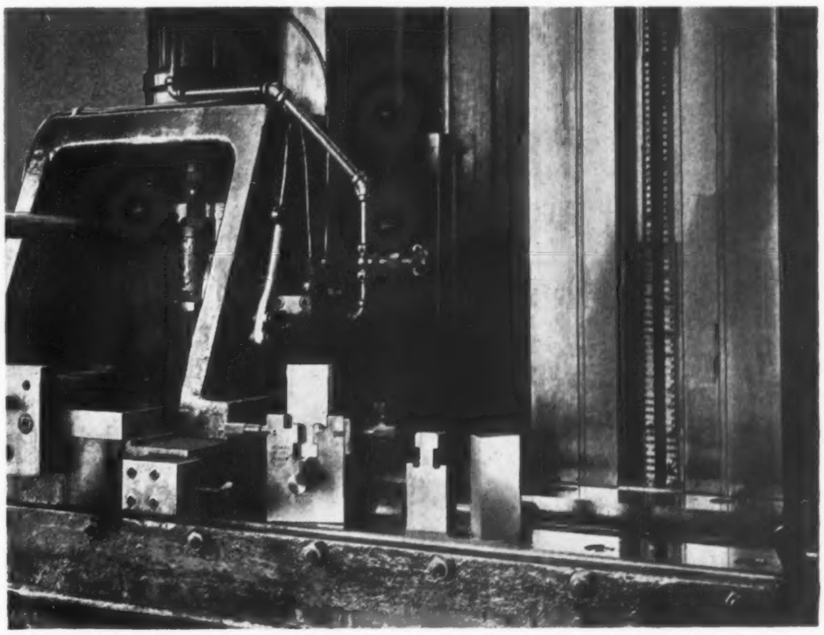
Fig. 4. (Left) Some Types of Blades are Built up from a Piece of Non-corrosive Steel, Rolled to the Required Shape, and a Shank, the Two Pieces being Brazed Together. Fig. 5. (Right) Impulse Blades Machined from Rectangular Blocks of Non-corrosive Steel

In forging low-pressure blades, pieces of stock cut to the required length are first heated in a furnace and then forged beneath a Bradley hammer to the shape shown in Fig. 2. Then the blade is formed accurately to shape in a series of from two to ten operations under a drop-hammer equipped with a single-impression die, as illustrated in Fig. 3. After each forging operation, the blade is heat-treated and pickled, and then again heated for forging. When the required dimensions have been obtained, the blade is trimmed, again heat-treated and pickled, and finally sand-blasted. A minimum amount of machining is performed on the front and back of the blade proper, although the shank end or "root" is machined to fit into the grooves of the turbine rotor or cylinder, and the edges of the blades are finished to the required width.

Fig. 4 shows several sizes of built-up blades. The blade proper is made of flat non-corrosive steel stock which has been rolled to the desired contour. The smaller blades are rolled cold and the larger hot. This rolled stock is cut off to the required length and brazed to a "packing piece" before any machining operations are performed on the root. Every blade must meet a specified Brinell hardness reading.

Impulse blades are of the construction shown in Fig. 5, and are completely machined from rectangular blocks of non-corrosive steel. One of the operations on these blades consists of broaching the root in a Lapointe double-ram machine equipped with a fixture such as shown in Fig. 6. This fixture is transferred from ram to ram between loadings of the work, so that a piece can be broached with one ram while the other returns to its starting position. With this arrangement, only a small portion is lost of the time consumed by the rams in making their return stroke of 84 inches. A stroke of that length

Fig. 6. The Slotted End of Impulse Blades is Broached Complete in the Double-ram Machine Here Illustrated



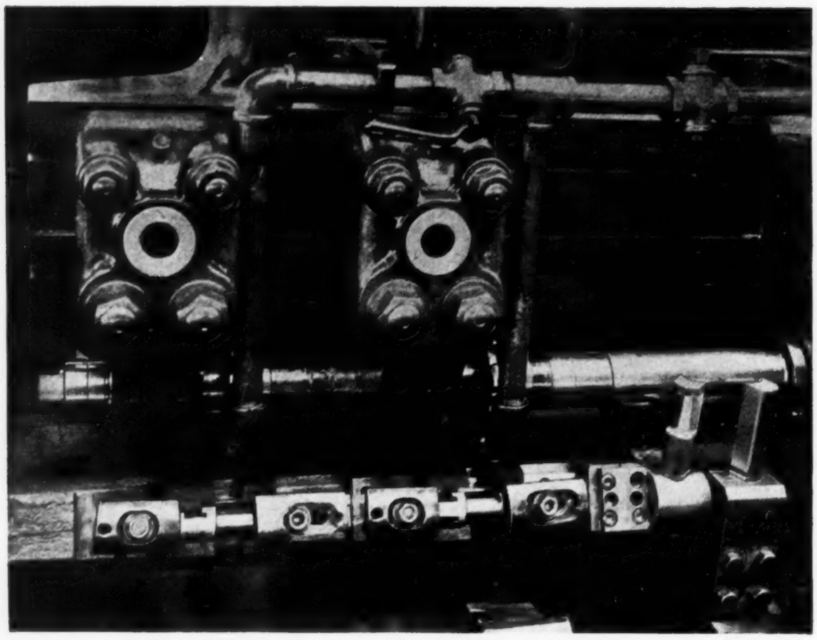


Fig. 7. Milling Port Surface of Impulse Blades to a Curve Bounded by Two Tangents. A Blank and a Finished Piece are Shown at the Right of the Fixture

is necessary in order to remove a large amount of stock in one stroke, a typical block being 1 1/8 inches thick.

Hydraulic power enables the work-fixture to be quickly transferred between the two rams, and the blades are also clamped in the fixture by hydraulic means. Two of the surfaces broached must be parallel within 0.0005 inch, and two other surfaces must be in line within 0.001 inch. Each blade is carefully checked by means of the micrometer gage seen on the table of the machine.

A number of interesting operations are performed in finishing the impulse blades to the required contours and dimensions. The curved port surface above the shank end, as seen in Fig. 5, is produced in the Cincinnati milling machine illustrated in Fig. 7. At the right-hand end of the work-fixture is seen a blank before and after the operation, the part being of somewhat different design from those shown in Fig. 5. Two pieces of stock are mounted in the fixture for simultaneous milling. The work-fixture oscillates about its axis in this operation, and the cutter-head moves back and forth and also up and down to mill the ports of the blades to two angles and to a curve at the same time.

Reaction blades are milled on the front and back to the required contour and on the base end to a taper in the DeVlieg machine shown in Fig 8. While a part in one fixture is being milled on the base end two blades are being loaded into the fixture seen in the illustration, ready for the contour milling cuts. Each blade must be placed successively in the two stations of this fixture, once with the front side uppermost and once with the back side toward the top. Formed cutters are employed in this operation to mill the blades to the required shapes.

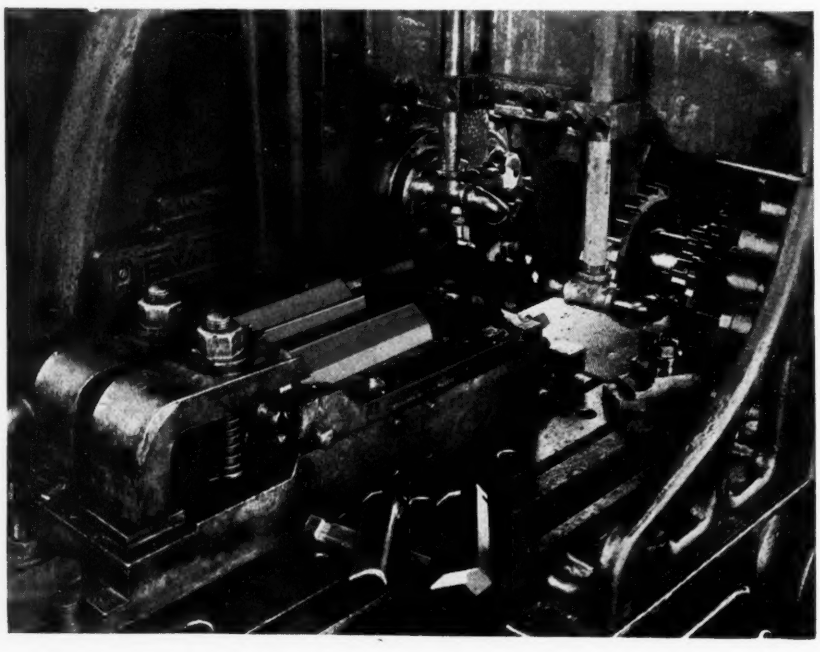


Fig. 8. Front and Back of Reaction Blades are Milled in a Two-station Fixture, and Base End in a Second Fixture at Opposite End of Table

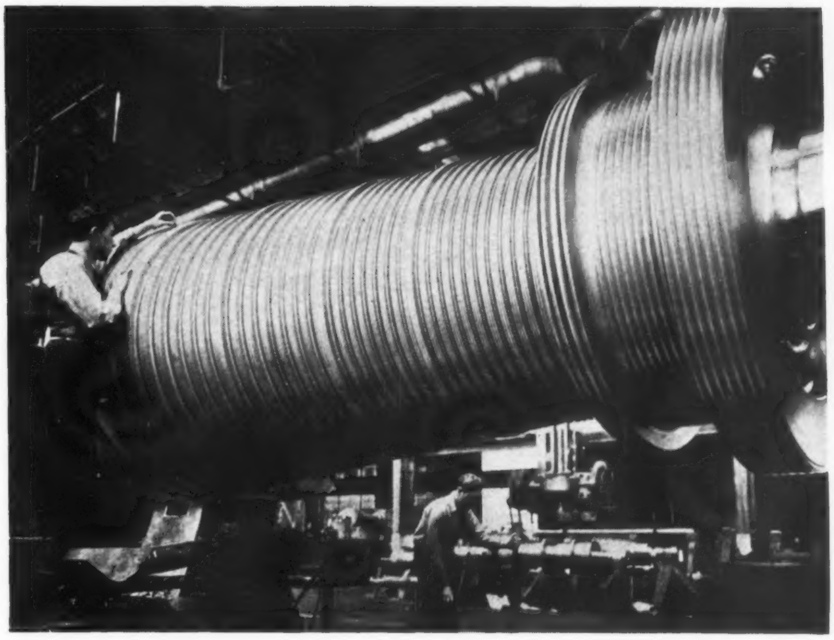


Fig. 9. View of a Large Rotor for a Land Turbine, Showing the Large Number of Grooves that Must be Machined to Close Limits to Receive the Turbine Blades

The machining of turbine rotors and cylinder castings to receive the blades, as illustrated in the heading illustration and in Fig. 1, requires the utmost care. Grooves corresponding in shape to the slotted blade shanks must be turned around the rotors and bored around the inside of the cylinder castings. The nature of these grooves can be observed by reference to the machined rotor seen in Fig. 9, which, however is for a land turbine and not for a marine turbine. The rotors are made from steel forgings. They are grooved in a large lathe, and the cylinders either on a vertical or a horizontal boring mill, the cylinder halves being sometimes bored separately and sometimes with the two halves bolted together.

In machining the grooves in either a rotor or a cylinder, the first tool used rough-turns or bores the groove to its full depth. Then a tool that cuts at four points turns the neck of the modified T-slot and the full width of the slot at the top. Next, a tool is used that under-cuts the neck to form one side of the slot at the bottom, after which a tool of the opposite hand under-cuts the slot on the other side. Three or four grooves are machined at one time. The machining of comparatively simple grooves has been outlined here; more complicated grooves require the use of eight to ten different tools. The operator of the lathe or boring mill is furnished with a list of all the tools and gages required for a job and obtains them in one box from the tool-crib.

In order to machine the two under surfaces of the T-slot neck accurately in line, it is necessary to check the distance of these surfaces from the top of the rotor or the inside of the cylinder by means of micrometers. These surfaces must be machined

Fig.10.Spinning Machine in which a Double-roller Tool is Employed to Rivet Shrouds over the Tips of Some Types of Turbine-blade Units

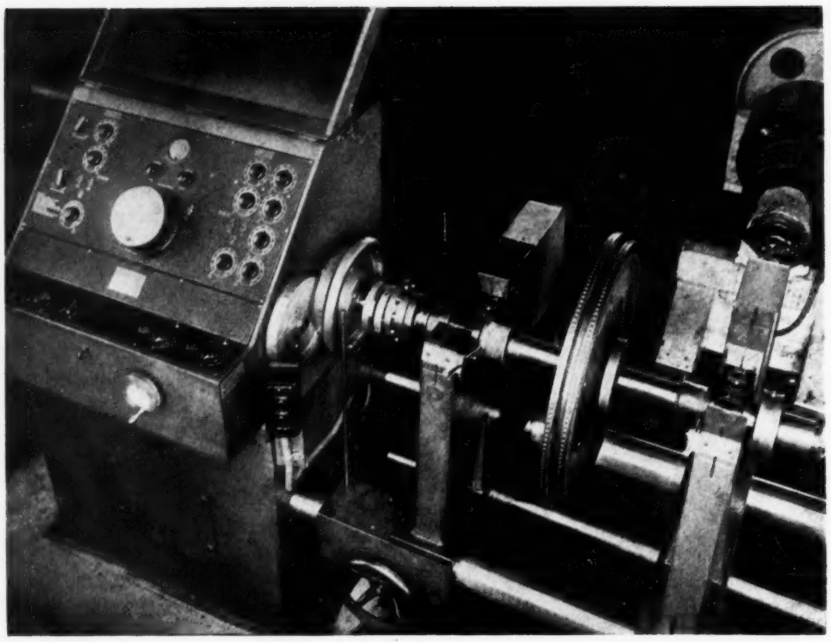


Fig. 11. Sub-assemblies for Rotors, as well as the Rotors Themselves, are Dynamically Balanced. This View Shows an Assembled Single-disk Rotor in the Machine for Final Balancing

to the specified diameter within 0.002 inch on diameters that range up to 48 inches, and, in addition, must be in the closest possible alignment. The under-cut width of the grooves is 2 1/16 inches for the largest blades used and 7/16 inch for the smallest. On certain jobs, the distance between grooves is held to extremely close tolerances, as well as the dimensions of the grooves themselves. The average number of grooves in a rotor is twenty, and each groove is designed to hold from 100 to 125 blades, which must fit closely in order to avoid any circumferential movement of the blades when the rotor runs at high speed.

Shrouds are assembled on the tips of some types and sizes of blades. This operation is performed in several ways, as, for example, by the spinning machine shown in Fig. 10, or by a high-speed hammer. In both operations, small peg-like projections milled on the tips of the blades are rounded into countersunk holes in the shroud. It is important that a well formed rivet head be obtained on each blade without distorting the blade itself. The rivet-spinning machine employs a tool in the horizontal spindle that comprises two rollers which are free to turn about their own axes as they revolve with the spindle. The latter runs at from 750 to 1150 R.P.M.

The smaller sizes of assembled rotors are balanced in a dynamic balancing machine of the type shown in Fig. 11, which has a capacity for parts weighing up to 4200 pounds. It is claimed that unbalance can be determined to one-fiftieth of an ounce-inch. Balance can be checked in both ends of the work by merely operating electrical switches. Any unbalance in the work causes the rests on which the rotor is supported to vibrate and produces changes in the resistance of electrical circuits.

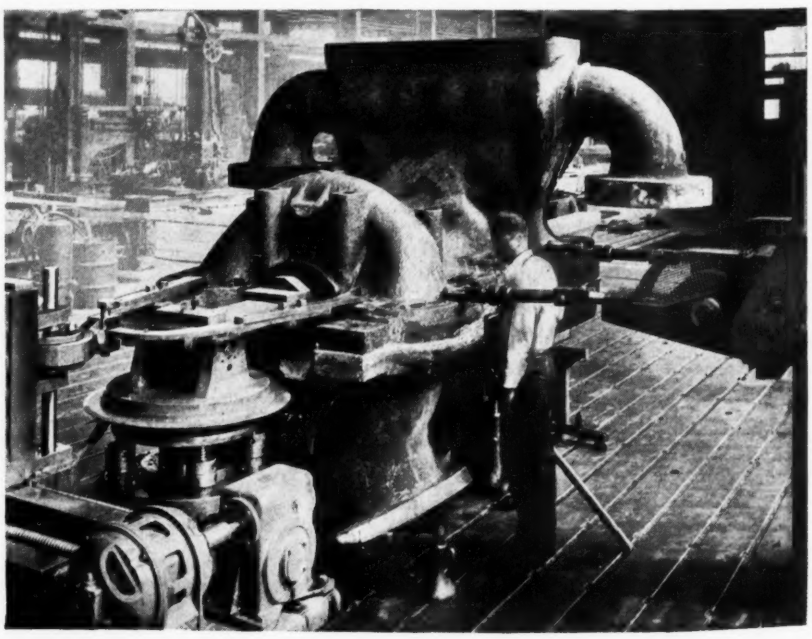


Fig. 12. A Steam-tight Fit Between the Joint Faces of Cylinder Halves is Obtained by Means of This Lapping Equipment

Corresponding readings are indicated on the panel board to show the location and amount of unbalance. Several balancing machines, of various types, accommodate rotors of any size required.

Steam-tight joints between the halves of the cylinder castings are obtained by lapping the joint faces of these castings together. This operation is performed on the special machine shown in Fig. 12, which imparts a figure-eight oscillating motion to the upper cylinder casting while the lower casting is held stationary. The mechanism in the foreground tends to move the upper casting longitudinally through the operation of a crank, and, at the same time, the mechanism at the left reciprocates the casting sidewise, thus resulting in the figure-eight movement. A suitable lapping compound is applied between the joint faces at the beginning of the operation. Prior to the use of this lapping machine, the joint faces of cylinder castings were hand-scraped. Although Fig. 12 shows a cylinder for a land turbine, the same equipment is used on marine turbine cylinders.

* * *

Gas-Cutting of Ship Plates with Portable Machines

The use of small automatic oxy-acetylene machines for cutting out plates to various outlines, with openings of any shape and size required, is constantly expanding. A typical application is illustrated in Fig. 1. The required edges and openings of the plate shown were first marked in chalk by the use of templets. Then the gas-cutting machine was guided on tracks along the chalk lines to cut the plate to the desired shape.

The No. 10 Radiagraph machine is generally operated at a speed of 20 inches a minute in cutting plates 1/2 inch thick; it can be operated at speeds of from 4 to 60 inches a minute, depending on the thickness of the work. This machine, which is a product of the Air Reduction Co., is driven by an electric motor that operates on 110-volt alternating or direct current.

Machines of this type are also used, as shown in Fig. 2, for beveling the edges of plates to prepare them for butt-welding to other plates. The oxy-acetylene torch is inclined at the required angle, generally 45 degrees, and the machine is operated automatically along a track that is laid parallel with the edge being beveled.

* * *

A recent number of *Industrial Britain* mentions the fact that the British automobile plants now produce about 500,000 vehicles each year, of which nearly 400,000 are passenger cars. The industry as a whole, including service shops, filling stations, etc., provides employment for 1,300,000 people in Great Britain.

Fig. 1. (Left) Large Plates are Cut out to Required Outlines by the Use of Small Portable Oxy-acetylene Machines

Fig. 2. (Above) Automatic Radiagraph Oxy-acetylene Cutting Machine being Used for Beveling the Edge of a Plate Previous to Welding

EDITORIAL COMMENT

How to Encourage the Starting of New Industries

According to an Associated Press report, the new governor of Texas, W. Lee O'Daniel, is proposing to help finance new industrial enterprises that are willing to locate in the state, through the use of state funds for purchasing preferred stock in these companies.

There are better means of encouraging greater industrial activity, both of old and new companies, than that proposed by the Texas governor. Through rational methods of taxation, industry could be encouraged to locate in Texas, since all other states, by their chaotic and ancient methods of taxation, do a great deal to discourage industry from starting and operating within their domain. Methods of taxation can make or break industrial progress; yet it is surprising that so very few men in high governmental positions as well as in the business world, have thought it necessary to acquire a fundamental knowledge of the principles of rational taxation. Our tax system is almost wholly based on the principle of the old robber barons—"Take it where you can get it." A rational method of taxation, which still is waiting to be applied, would enunciate the principle that government should exact taxes only in proportion to the benefits conferred upon the taxpayer by the government. That would be a new deal, indeed, in taxation.

A Forgotten Fact, or Putting the Cart before the Horse

In all the agitation for higher wages and minimum wage laws, it seems that the cart has been put before the horse, and that a very fundamental fact has been overlooked. Nothing has been said about providing adequate training for industrial workers, so that they will be capable of earning the higher wage. After all, a man's pay is not something that can be arbitrarily determined. If he is capable of doing a certain kind of work, he is worth so much; if he is not capable of performing that type of work, he would not be worth as much as one who is; but properly conducted industrial training will always make men worth more than if they are unskilled. It is not enough merely to talk about a living wage; it is equally important that men and women be so trained that they will be capable of earning this living wage. That important fact seems to have been forgotten.

Without the Machine What Would Life be Like Today?

To men engaged in the mechanical industries it is obvious that the advance in engineering and the development of machinery during the past century have been the greatest factors in raising the standard of living. But we find many public officials and labor union leaders voicing the thought that modern machinery has injured rather than benefited the great mass of working people.

In view of this, a comparison of the conditions of life of the average worker a hundred years ago and today should be of interest. At that time, the hours of labor were from sunrise to sunset, six days a week; little beyond the bare necessities of life could be secured for the small wage that these long hours brought. Food was of the simplest, with little or no variety; fresh meat was a luxury, and fresh fruit and vegetables were available only in the season when they ripened. Skilled workers wore fairly substantial clothing, but there were few articles in their wardrobe, and it was only at intervals of several years that a new suit of clothes could be afforded. The unskilled workers were less fortunate; their clothing was neither substantial nor plentiful. Houses were poorly heated, and had no conveniences of any kind. Industrial workers of today would consider the living conditions of that time intolerable.

What is the reason for the great change in living standards that has taken place in a hundred years? What is it that has made comfortably heated homes, abundant and varied food supplies, better and more comfortable clothing, electric light, radios, electric irons, washing machines, and automobiles available to almost everybody? It is engineering and machines—nothing else. Without the inventive ability of the engineer and the enterprise of the machine builder, we should live today exactly as our forefathers lived a hundred years ago.

One cannot help but wish that it were possible to have those who decry the machine age moved back a century in time, so that they might live for a short period under the conditions of life that prevailed in those days.

CAUSES AND CURES OF ARC-WELDING TROUBLES—5

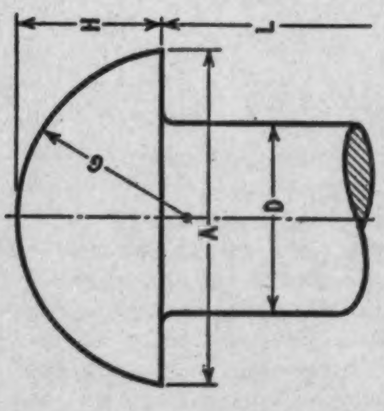
Trouble	Cause	Cure
Corrosion	Type of electrode used. Improper weld deposit for corrosive media. Metallurgical effect of welding. Improper cleaning of weld.	Bare type electrodes produce welds that are less resistant to corrosion than the parent metal. Coated type electrodes produce welds that are more resistant to corrosion than the parent metal. Do not expect more from the weld than you do from the parent metal. On stainless steels, use electrodes that are equal or better than the base metal. When welding 18-8 austenitic stainless steel, be sure the analysis of the steel and the welding procedure are correct, so that the butt welding does not cause carbide precipitations. This condition can be corrected by annealing at 1900 to 2100 degrees F. Certain materials, such as aluminum, require careful cleaning of all slag to prevent corrosion.
Magnetic Blow	Magnetic field causing a direct-current arc to blow away from the point at which it is directed. Magnetic blow is particularly noticeable at ends of joints and in corners.	Proper location of the ground on the work. Placing the ground in the direction in which the arc blows from the point of welding is often helpful. Separating the ground in two or more parts is helpful. Weld toward the direction in which the arc blows. Hold a short arc. Magnetic blow is not present with alternating-current welding.

MACHINERY'S Data Sheet No. 387, February, 1939

Compiled by Westinghouse Electric & Mfg. Co.

AMERICAN STANDARD LARGE RIVETS—1

Button Head (Manufactured Shape)



Diameter of Body D			Diameter of Head A			Height of Head H		Radius of Head G
Nominal	Max	Min	Basic	Max	Min	Max	Min (Basic)	
1/2 0.500	0.520	0.478	0.875	0.938	0.844	0.406	0.375	0.443
5/8 0.625	0.655	0.600	1.094	1.157	1.063	0.500	0.469	0.553
3/4 0.750	0.780	0.725	1.313	1.391	1.282	0.594	0.563	0.664
7/8 0.875	0.905	0.850	1.531	1.609	1.500	0.687	0.656	0.775
1 1.000	1.030	0.975	1.750	1.828	1.719	0.781	0.750	0.885
1 1/8 1.125	1.160	1.098	1.969	2.063	1.938	0.891	0.844	0.996
1 1/4 1.250	1.285	1.223	2.189	2.283	2.158	0.985	0.938	1.107
1 3/8 1.375	1.415	1.345	2.406	2.500	2.375	1.078	1.031	1.217
1 1/2 1.500	1.540	1.470	2.625	2.719	2.594	1.188	1.125	1.328
1 5/8 1.625	1.665	1.588	2.844	2.938	2.813	1.282	1.219	1.439
1 3/4 1.750	1.790	1.713	3.063	3.172	3.032	1.376	1.313	1.549

All dimensions given in inches.
Proportions (Basic): A = 1.75D; H = 0.75D; G = 0.885D.

The length (L) is measured from the largest diameter of the bearing surface of the head to the point, in a line parallel with the axis of the rivet.

Rivets with fillets under the head of not more than 1/16-inch in radius are acceptable.

MACHINERY'S Data Sheet No. 388, February, 1939

Approved by American Standards Association, March, 1937

Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

Crank-Actuated Ratchet Mechanism for Operating Work-Transferring Turret

In developing a new machine, it was necessary to provide a turret, such as shown at *A* in Fig. 1, for transferring cylindrical work to the turret *B*. Turret *B* is 16 inches in diameter, has six semi-circular apertures with centers on the periphery, and revolves at a constant speed of 50 revolutions per minute. Obviously, the peripheral speeds of the two turrets must be the same, in order to permit proper transfer of the work.

It is desirable to have turret *A* dwell before each transfer takes place, making three dwells per cycle, and, if possible, have the duration of the dwell equal to one-half of the time elapsing between each transfer movement.

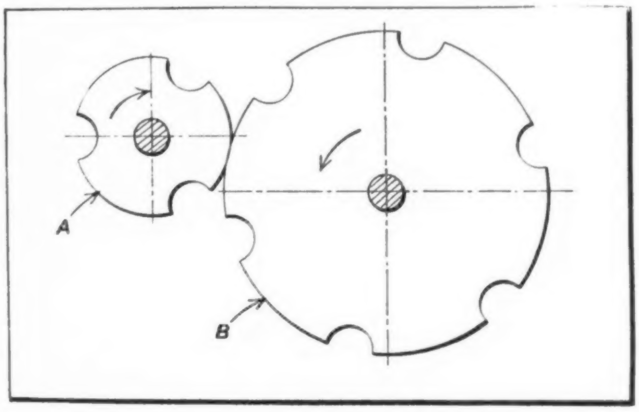


Fig. 1. Small Turret A, Rotating at Same Constant Peripheral Speed as Turret B, Transfers Work to Latter Turret

A crank-actuated ratchet mechanism such as shown diagrammatically in Fig. 2 was finally designed to operate turret *A*. The diagram Fig. 2 is intended to show the relationship of the parts rather than their actual location. The fulcrum pin of the oscillating lever is shown eccentric, the object being to enable the stroke of the pawl to be adjusted to coincide with the arc of movement of the ratchet, so that the end of the pawl will fall into contact with the ratchet tooth at the end of the dwell stroke. The ratchet teeth at the end of the pawl are also formed so as to secure this result. Vibration which might result from the oscillation of the lever can be eliminated by extending the end of the lever opposite the pawl, as shown by the dotted lines, in order to balance it.

If the work is fairly light in weight, a crankpin may be used without the sliding block. As will be seen in the diagram, one cylindrical piece of work is just clear of the large turret, while another is in such a position that, as the large turret turns while the small turret is at rest, it is barely free to pass out of the small turret. It is readily seen

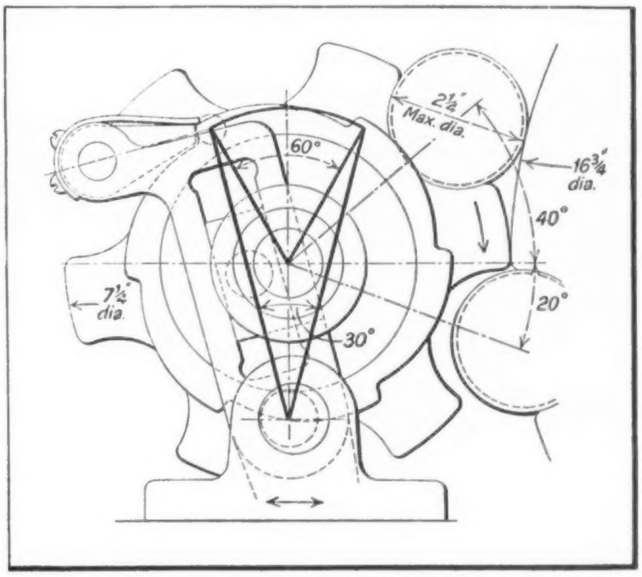


Fig. 2. Crank-actuated Ratchet Designed to Operate Transfer Turret without Shock

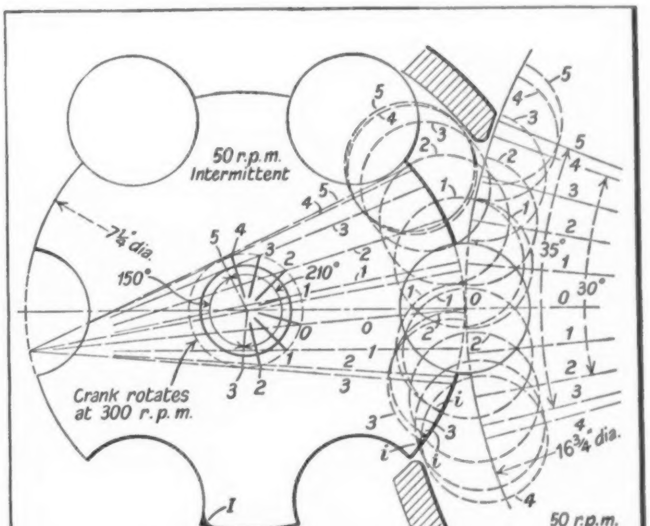


Fig. 3. Lay-out for Transfer Turret Such as Shown in Fig. 2

that the dwell position cannot vary greatly from that indicated by the 40- and 20-degree angles.

It will be noticed that the turret diameters given in Fig. 2 do not quite correspond with the proportions indicated in Fig. 1. The change was necessary because the speed of the small turret at the point of contact with the large one was greater than that of the large turret. To make the peripheral speeds coincide at this moment, it was necessary to alter the diameter ratio as shown. The diameters can be readily calculated after the position of the small turret has been determined by means of a lay-out such as shown in Fig. 3.

From Fig. 3, it will be noted that the turret will be free from interference with the work, except at the points *i*, which need rounding off, as at *I*. With work 2 inches in diameter, the interference is slight and might be offset by a flexible attachment of the small turret to the ratchet.

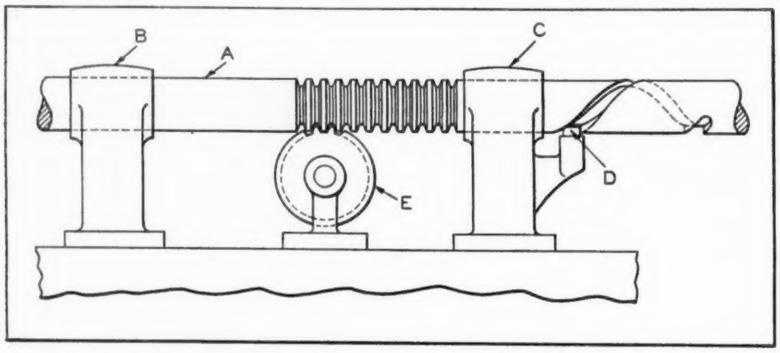
A brake may be provided to prevent the turret from turning during its dwell period or a spring plunger with a conical end designed to engage a countersink in the ratchet or the turret for each position might serve the purpose. The turret and ratchet should be arranged to permit angular adjustment in relation to each other, so that the apertures can be set to register at the moment the center line is crossed.

Combined Reciprocating and Rotating Motion

By L. KASPER

A mechanism for producing a combined reciprocating and reversing rotating motion, which is of particular interest because of its simplicity and compactness, is shown in the accompanying illustration. This mechanism is used to operate a "flying needle" on a machine for producing a woven-wire product.

The shaft *A*, which is supported in bearings *B* and *C*, has a series of modified gear teeth on it which mesh with the teeth of gear *E*. The base of bearing *C* carries the roller *D* which engages a helical groove in shaft *A*. In operation, gear *E* is given a reversing rotary motion by means of a sliding dog mechanism. As shaft *A* is reciprocated by gear *E*, it is also given a reversing rotating motion by the action of roller *D* in the helical groove. This arrangement provides a smooth uniform motion.



Mechanism for Reciprocating and Rotating Shaft A

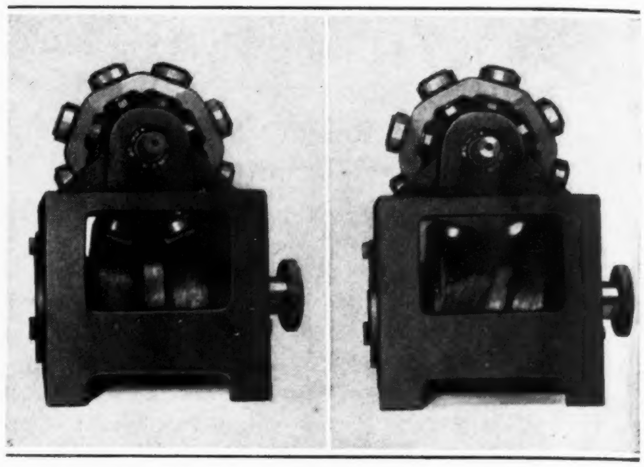


Fig. 1. Intermittent Mechanism in the "Rest" or Locked Position

Fig. 2. Mechanism Shown in the Working or Moving Position

Intermittent Worm-Gear Mechanism

By ALFRED G. HOLLMANN
Alpha Machine & Tool Co., St. Louis, Mo.

The two designs of intermittent worm-gear mechanisms described in June MACHINERY, page 678, have certain disadvantages not found in the mechanism shown in the illustration accompanying the present article. One of the disadvantages of the mechanism shown in Fig. 1 of the previous article is the difficulty encountered in generating the cam or worm thread. The mechanism shown in Fig. 2 of the previous article has no provision for taking up lost motion, except through the use of tapered rolls. In both of the previously described mechanisms, the slots for the cam-rolls are required to be wider than the roll diameters, in order to permit the rolls to rotate.

The cam of the mechanism here illustrated is cut by a patented generating method. This method permits the cam to be machined to suit any acceleration and deceleration curve desired. This mechanism is a demonstrator's model, Fig. 1 showing it in the "rest" or locked position, while Fig. 2 shows it in the moving or working position.

A typical application of this mechanism is an installation on a printing press for feeding and registry duty. For this purpose, the drive consists of a cam cut with a left-hand thread which has a working period corresponding to an angular movement of 240 degrees. The roller gear of this installation makes four stops in one revolution.

The form of acceleration used in the printing press installation is represented

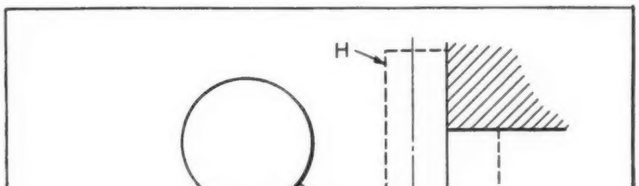
by what may be termed a modified trapezoidal curve. The feed-drum operated by this mechanism is approximately 19 inches in diameter and handles a paper web 9 inches wide, moving it 15 inches per stroke at the rate of 148 strokes per minute, or about 185 feet per minute. The acceleration and deceleration load is therefore quite high.

Link Mechanism for Operating Combination Furnace Door and Work Plate

By PAUL GRODZINSKI

A door for a modern high-temperature furnace must be so designed that it can be opened quickly; it must be a tight fit in the closed position and take up a minimum amount of space. A door designed to meet these requirements is used by M. Hereaus, Hanau a/M., Germany, on muffle type furnaces operating at temperatures up to 1000 degrees C. (1832 degrees F.). The door of the furnace is suspended on a multiple-link arrangement, so that when it is opened it rotates through an angle of 90 degrees, which brings its upper side into a horizontal position for supporting the parts requiring heat-treatment.

The door plate shown at *P* in the accompanying illustration is actuated by a link *A* and is guided by a longer link or arm *C*. When the door is closed by rotating link *A* in a clockwise direction, plate *P* will be in the vertical position indicated by dotted lines at *H*, with the muffle in the position shown by the dotted lines at *K*. After rotating arm *A* about 135 degrees counter-clockwise, the door reaches the open horizontal position shown by the full lines. On the first part of the closing movement, the end of the door that is nearest the furnace rises without withdrawing from the furnace far enough to leave an opening through which small parts would be able to fall.



Link Mechanism for Operating Furnace Door

The front edge of the muffle must be inclined as shown at *E* in order to permit it to clear the edge of the door opening at *F*. The door is counterbalanced by a weight attached to arm *A*, which serves also as a crank for operating the door. The length or dimension *B* between the pivoting points on plate *P* and the length of link *C* can be calculated if the length of link *A* and dimension *D*, as well as the angle *a* are given, using the formulas:

$$B = \frac{AD\ (1 + \cos a)}{A\ (1 + \sin a) + D}$$

and

$$C = A + D - B$$

Example—$A = 3$ inches; $D = 12$ inches; $a = 45$ degrees; $\sin a = 0.707$; and $\cos a = 0.707$.

Substituting the numerical values in the preceding formulas, we have,

$$B = \frac{3 \times 12\ (1 + 0.707)}{3\ (1 + 0.707) + 12} = 3.57 \text{ inches}$$

and

$$C = 3 + 12 - 3.57 = 11.43 \text{ inches}$$

The link mechanism described can also be used to advantage for other purposes, such as supporting tables where space is limited, as it permits the tables to be easily folded upward against the walls.

* * *

Employment Service of the National Industrial Advertisers Association

The National Industrial Advertisers Association, 100 E. Ohio St., Chicago, Ill., has decided to continue, as a permanent activity, the free employment service it inaugurated on an experimental basis a year ago. Companies seeking men for positions requiring knowledge and experience in the fields of industrial advertising, marketing, sales promotion, research, or publishing are invited by the Association to take advantage of this service. The inquiries directed to the office of the Association in Chicago will be forwarded to the chapter of the Association in the area from which the inquiry originated. The Association now has seventeen such chapters located in the principal industrial areas, with a total membership of 1200. Men and women seeking positions in the fields mentioned are invited to avail themselves of this service.

Engineering News Flashes

The World Over

New Type Steam-Turbine Electric Locomotive

An entirely new type of electric locomotive, carrying its own steam-turbine power plant and claimed to be capable of doing twice the work of the conventional locomotive for each pound of fuel consumed, has recently been completed by the General Electric Co., at Erie, Pa. This engine is also capable of making three times the mileage, without stops for fuel and water, of the conventional locomotive. Nearly two years have been spent by the General Electric Co., in collaboration with Union Pacific engineers, in designing and building this locomotive. It is the first of its kind in the world and differs from any of the turbine types that have been built in European countries. It is capable of speeds up to 125 miles an hour. The fuel is oil, which is fed into a firebox rather than into a combustion engine cylinder, so that very low-cost petroleum, known as "bunker" oil, is used.

The locomotive, with its 5000-horsepower driving equipment and all auxiliaries, is housed in two cabs. The essential features include a geared turbine electric generating unit supplying electricity for operating six large driving motors in each of the two cabs. Each of the two units which makes up the complete two-cab locomotive weighs about 265 tons and is 90 feet long. This locomotive will enable the Union Pacific Railroad to handle its heaviest trains over the entire run from Chicago to the Pacific Coast without change of engine and without using a "helper" over the grades. It is designed to operate at 110 miles per hour for long periods, and up to 125 miles an hour where this speed is permissible. Continuous runs of from 500 to 700 miles, without stops, will be practicable.

An Automatic Machine that Makes and Fills Liquid-Proof Cartons

It is not in the metal-working and machine shop industries alone that highly developed automatic machines are used. A most remarkable automatic machine is now in operation that performs all the steps required for making and filling the cartons in which milk is sold. The machine shapes and glues the flat printed paper, paraffins and sterilizes the formed carton, fills it with milk or cream, and finally seals, dates, and applies tamper-proof staples to the package. In the construction of this machine, all the metal parts that come in contact with the milk are constructed of solid nickel-silver, in order to guard against corrosion and make thorough cleaning easy. The machine makes and fills these waxed paper cartons at the rate of over 2000 an hour.

A Nickel-Lined All-Welded Freighter Built Near Rochester

What is probably one of the most unusual ships in design and construction ever to visit the port of New York is the 4000-ton Diesel-ship *Dolomite 4*. This vessel was built in an abandoned lock of the Erie Canal, near Rochester, N. Y., and literally never was launched. When her hull was completed, water was admitted to the lock, whose gates were then opened to permit the ship to pass into the barge canal. The vessel is 300 feet long and built to full ocean classifications under Lloyd's rating. She is built from welded steel channels and plates, without rivets.

One of the unusual features of the ship is that she has five main bulkhead cargo holds lined on all sides with 16-gage sheet nickel, spot-welded to the frame and arc-welded on the seams. More than 60,000 pounds of nickel were used for this lining. As a result, the ship can carry directly in the hold a great many materials, such as lye or caustic soda, and other chemicals, without causing corrosion or rust.

An Electric Generator with an Output Voltage of 1,200,000

So-called surge generators are no longer used solely in research. They are now being built for routine testing to verify the rated impulse strength of transformers, insulators, lightning arresters, circuit-breakers, and any type of insulation that must withstand lightning. Recently, the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., built such a surge generator for the American Transformer Co., at Newark, N. J. This new generator has an output voltage of 1,200,000 and an energy output of 15,000 watt-seconds. At full voltage, it can produce a lightning discharge current of 15,000 amperes, lasting, however, only for a small fraction of a second. Could such a current be maintained continuously at the full rated voltage, the generator

would supply enough energy for a city three times the size of New York.

With all the capacitor units connected in parallel, the generator can produce a surge current of approximately 60,000 amperes at 100,000 volts. The device rests on a steel plate occupying a floor space about 8 1/2 feet square, and has an over-all height of nearly 13 feet.

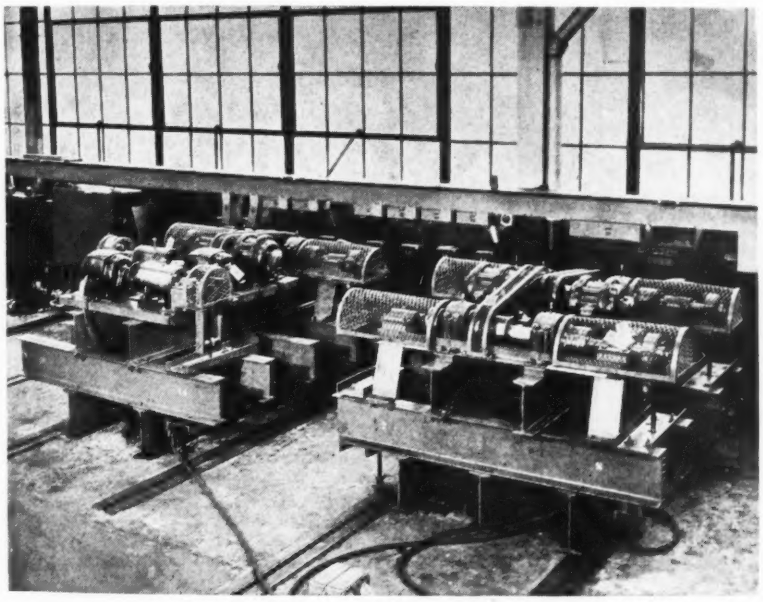
Aircraft Industry Expands in Great Britain

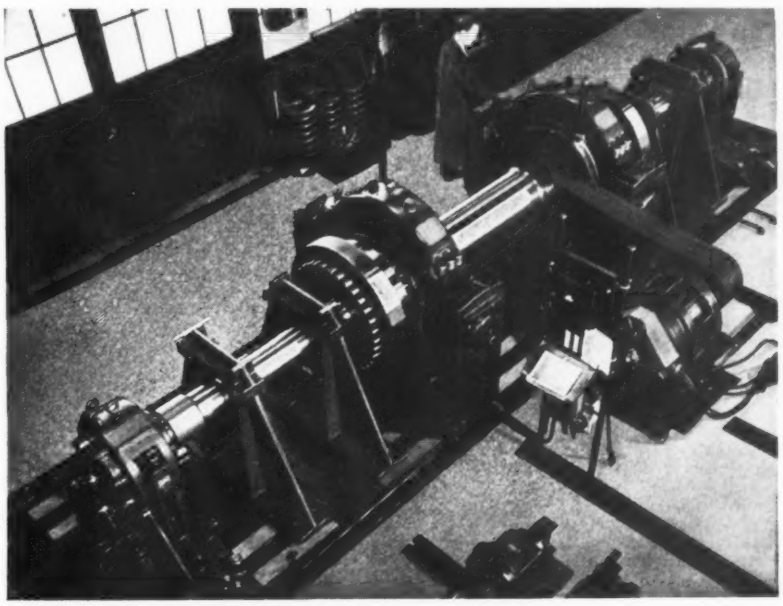
The tremendous advance in the aircraft industry in Great Britain is indicated by the fact that the Birmingham City Council recently sold 120 acres of the city's land for an aircraft plant, erected and equipped at an expenditure of about $15,000,000. It will provide employment for about 15,000 people. Another plant near Birmingham, the Austin factory at Longbridge, employed at first 5000 people in aircraft work; this number, it was expected, would later be increased. Two large mills formerly utilized for cotton spinning have been converted into plants for the aircraft industry in Manchester, and the capacity of another plant, near Liverpool, is being increased by over 40 per cent to employ ultimately 5000 people in the making of airplane frames.

Preventing Press Accidents by Light Beams

At the recent metal exposition in Detroit, the Electronic Control Corporation, of Detroit, exhibited a miniature press provided with an "electric eye" safety device. A curtain of light beams is projected within an area 12 inches high in such a manner that if the operator's hands intersect the light beams at a time when the hands would be endangered, the press will stop. The control equipment can be set for "automatic repeat," so that each cycle of the press will start automatically if the light curtain is unobstructed at the time of the beginning of the downward stroke. If, however, there is an obstruction in the path of the light, the press will stop in the open position, and a starting button must be pushed to operate the cycle again. The control can also be so arranged that when the operator walks away from the press, it will stop in an open position; but if it is loaded in synchronism with the cycle, and the operator's hands are removed in time, there will be an automatic repetition of the cycle.

The applications of the electric eye in the operation of machine equipment of all kinds are constantly increasing, because of the great convenience of the new device.





Fatigue Tests of Small Axles are Made in the Timken Roller Bearing Co.'s Testing Laboratory on the Machines Shown in the Illustration Above, which Handle Axles up to 2 Inches in Diameter. For Locomotive Driving Axles Mounted on Roller Bearings and Operating at High Speeds, the Machine Shown to the Right is Used. This is the Only Machine of Its Kind in Existence. Two Axles, 9 Feet Long and up to 14 Inches in Diameter, can be Tested Simultaneously in This Machine, One being Mounted at Each End. Loads of 80,000 Pounds per Bearing can be Applied while the Machine is Running at Speeds up to 1100 Revolutions per Minute, the Drive being by Means of a 100-horsepower Variable-speed Motor

Flush-Riveting in Airplane Construction

By THORLEIF HOLTHE

Flush-Riveting is Employed in Airplane Construction to Reduce Air Resistance and to Improve the General Appearance of the Airplanes

TWO distinct types of flush-riveting are in general use in the airplane building industry, namely, the countersunk joint and the "flared" or "dimpled" joint. The type of joint used depends primarily on the thickness of the material to be riveted. When the outer material is over 0.064 inch thick, the countersunk joint is used, as shown at *A*, Fig. 1. The outer plate *a* is drilled and countersunk, while the inner plate *c* is drilled the same size as the rivet. Either a round-head rivet, which is inserted from the inside, or a countersunk rivet, which is inserted from the outside, can be used.

When the outer and the inner material are 0.064 inch or less thick, the flared joint is employed, as shown at *B*. The outer and inner plates are drilled during assembly, and the holes are flared independently. If the outer plate is less than 0.064 inch thick and the inner plate, or support, is over 0.064 inch thick, a combination of these joints is used—that is, the outer plate is flared and the inner part is countersunk, as shown at *C*.

The objection to the flared joint shown at *B*, is that the rivet head on the inside of the joint will be supported on the edge of the flare only. This joint, however, can be improved as follows: After the sheets have been flared, they are assembled for riveting, the countersunk rivet being inserted from the outside. A special setting tool is then used on the inside. This tool has the same angle as the flare, but near the hole it is curved inward, so that when the countersunk head is backed up on the outside, the setting tool will force the flare closer to the rivet shank, and at the same time, flatten the edge of the flare, thus giving a better support for the rivet head, which is formed immediately after this operation. A joint formed in this manner is shown at *D*.

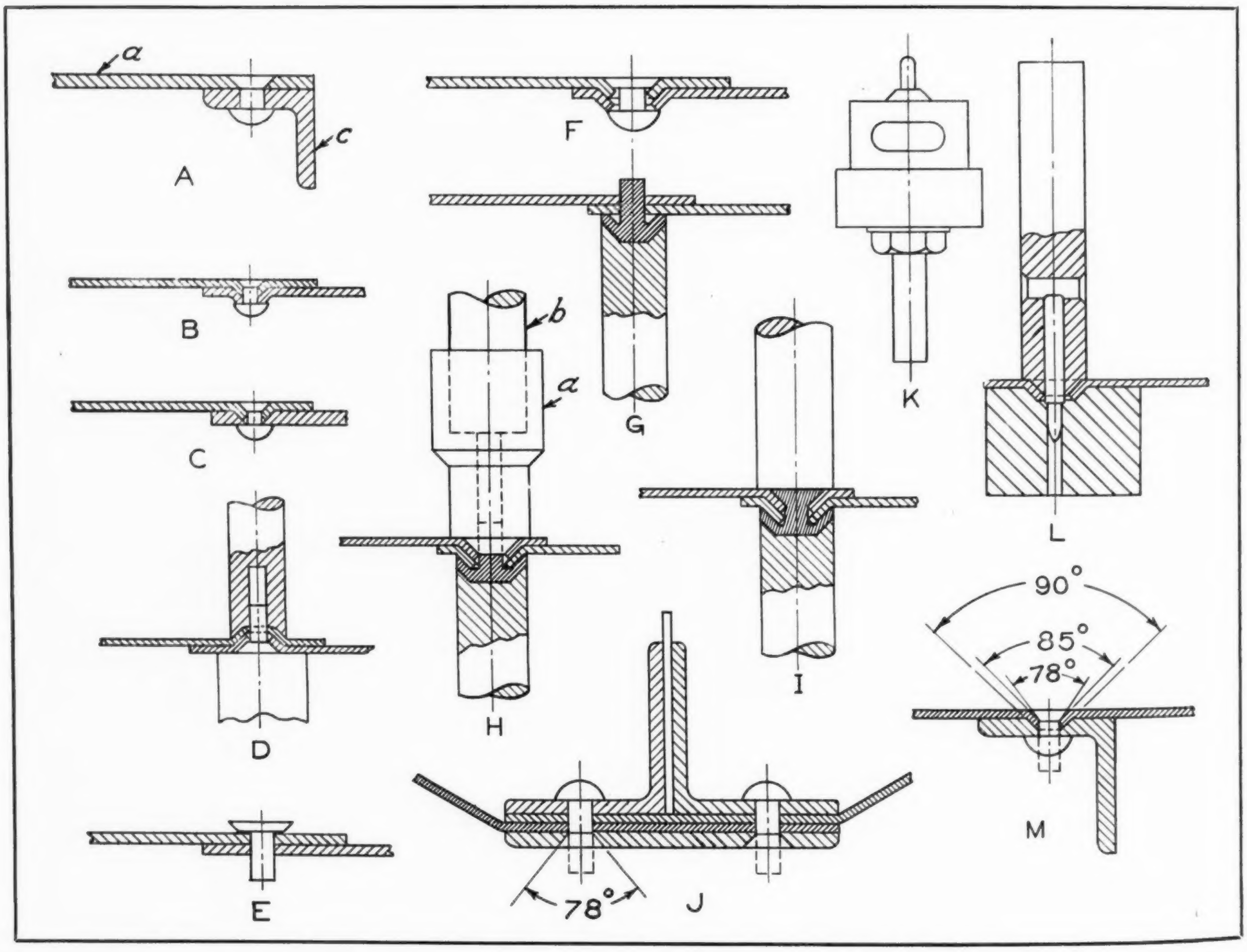


Fig. 1. Examples of Riveted Joints Employed in Airplane Construction, and Tools Used in Riveting

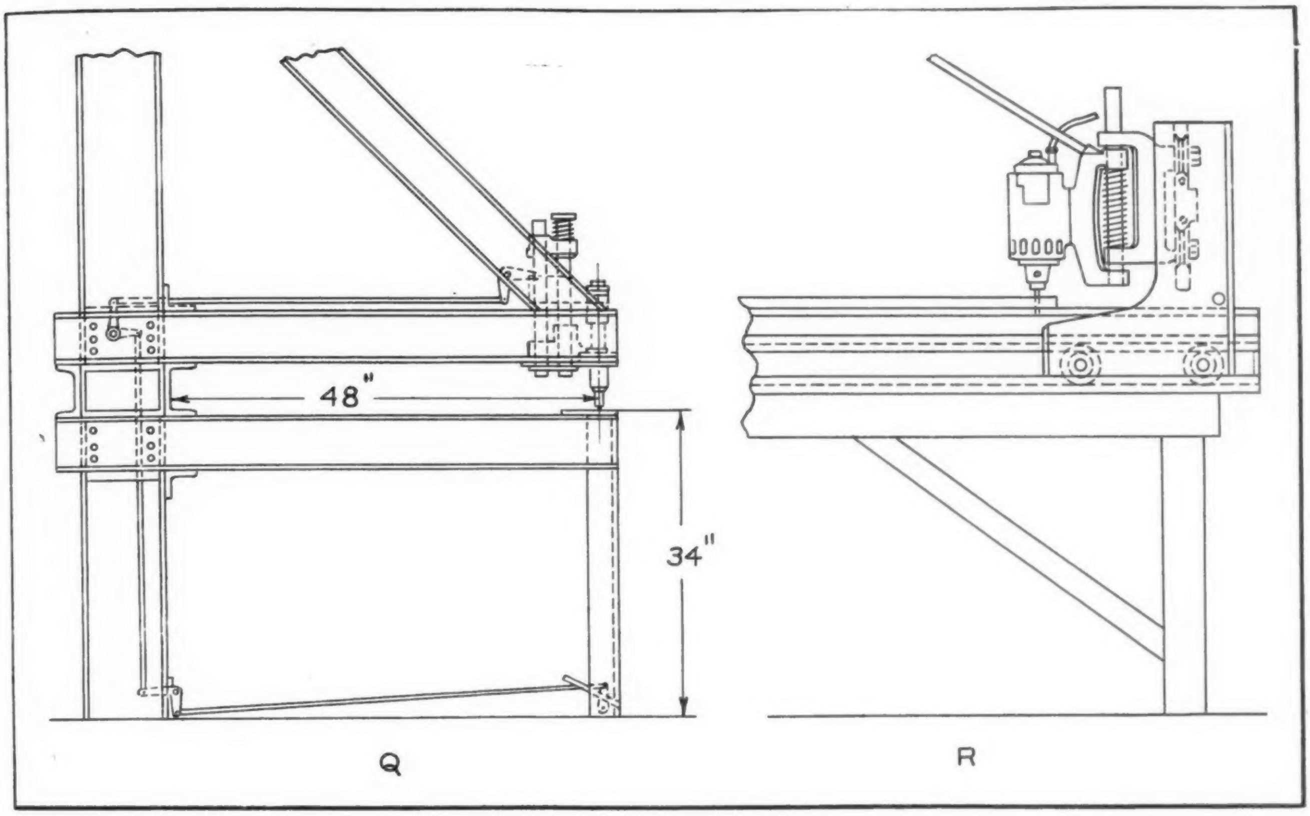


Fig. 2. "One-shot" Riveting Gun Rigged up on a Steel Frame for Use in Flaring Rivet Holes in Sheet Material up to 48 Inches Wide, and Arrangement for Drilling Stacked Sheets

Another type of flared joint is shown at *E*. A special countersunk rivet having a very shallow head is used for this joint. The sheets are drilled and assembled, after which the countersunk rivet is inserted from the outside. The countersunk head is then forced inward so that the thin material, or "skin," is flared, and the head is formed on the inside, as shown at *F*. The main objections to this type of joint are that the flare cannot be inspected for cracks, and that the rivet head, on the inside of the joint, is supported on the edge of the flare. Another objection is that flaring enlarges the hole. As the rivet is inserted before flaring, the holes cannot be drilled under size, and the openings between the rivet and the thin metal will not be filled up. Consequently, a joint of this kind should not be used where a water-tight seam is desired.

The types of flared joints described are used mainly in connection with countersunk rivets where the rivet head is to be formed on the inside. This method of riveting, however, is not the fastest, and in many places on wings, hulls, floats, etc., it is not possible to form the head on the inside of the thin metal or skin. For such locations, a joint using a cup-head rivet, inserted from the inner side, has been developed. The cup-head rivet can be round, as shown at *O*, Fig. 3, or of conical shape, as shown at *N*. The conical type is preferable, as it is lighter and can be tightened more effectively around the flare than the round type. However, the conical-head rivet is more difficult to manufacture.

In making the joint with cup-head rivets, the procedure is as follows: After the holes in the skin have been drilled and the metal has been painted and assembled, the cup-head rivet is inserted from the inside and held in place by a "bucking" iron, as shown at *G*, Fig. 1. A special flaring tool *a* (see view *H*, Fig. 1) which slips easily over the riveting tool *b* is then used as shown. A blow on the riveting tool *b* causes the flaring tool to force both the outer and the inner skins tightly against the inside of the cup-head rivet, which acts as a forming die. The flaring tool is then removed and the riveting tool *b* is used, as shown at *I*, for forming the rivet head flush with the skin. Naturally, either hand-riveting or a slow-hitting hammer can be used for performing this operation.

This type of joint will make a very strong seam, as the cup-head rivet will press the "flares" tightly together and close the opening around the rivet stem. This is a very desirable joint for use in the construction of wings, floats, and tanks. In many cases, it will eliminate the necessity for using fabric, friction tape, or rubber to make the structure air- and water-tight. A joint of this type is cheaper to make than a plain joint with round-head rivets, as fewer blows are required to form the countersunk head than to form the round head. This advantage has been proved in many actual tests, in which more than 250 rivets have been set in one hour.

It is important that rivets of the correct length be selected, as otherwise the head will be either too shallow or too large and time will be lost in replacing rivets. When rivets of the proper length are used, only one blow is required for flaring and two

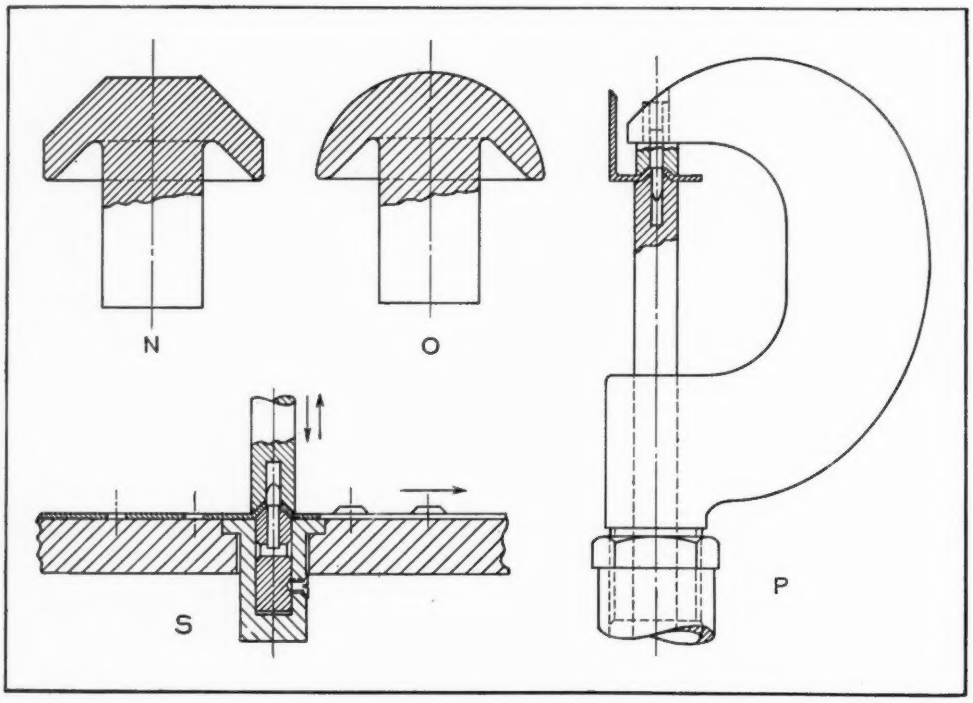


Fig. 3. Types of Rivets and Tools Used in Making Riveted Joints for Airplanes

blows for forming the countersunk head on a cup-head rivet of 1/8 inch diameter. This type of flush-riveting is limited to a total thickness of 0.064 inch for the joint.

General Rules for Flush-Riveting

In developing methods of flush-riveting to suit the different types of connections found in airplane construction, there are certain rules to be followed, based on practical experience. In a joint where the thickness of the skin is over 0.032 inch but within the practical limit for flaring (0.064 inch), the holes are drilled during assembly. After disassembling the joints, the holes should be slightly chamfered to remove the burrs from the edges. This can be done quickly by using a small hand-drill with a large size twist drill. Removal of the burrs from drilled holes is very important in all flared joints, as otherwise cracks are likely to develop in the flaring operation.

After the holes have been cleaned, the skin is flared. The simplest method of flaring is to perform the operation by hand, using one internal and one external punch, as shown at *L*, Fig. 1. Approximately 350 holes, 1/8 inch in diameter, can be flared by hand in an hour by one man. In production, however, it is recommended that a machine be used. The machine is not only faster, but produces more uniform and sharper flares.

To obtain a sharp flare without cracks, a sharp mechanical blow, as, for example, on a power press, is recommended. As machines for such purposes cannot be purchased, it is recommended that a "one-shot" riveting gun be rigged up on the end of a built-up structure, braced by a heavy steel wall column, as shown at *Q*, Fig. 2. This machine should have a gap of 48 inches, so that large-size sheets can be flared.

For machine-flaring, the external punch should be on the bottom or lower side of the work and should be attached to the table, while the internal punch should be mounted in the machine, as shown at *S*, Fig. 3. The sheet to be flared can then be moved over the table with the back side or the inside uppermost. Thus all notes or instructions regarding holes to be flared and the sizes of flaring should be written or marked on the back side of the sheet. The machine should be operated by foot, so that the operator can use both hands for moving the sheet from one hole to another. Approximately 500 holes can be flared by an experienced operator an hour.

In employing countersunk rivets, it is recommended that 78-degree countersunk rivets be used instead of 90-degree rivets. Considerable time is saved in countersinking, and a better and just as strong a joint can be obtained with a 78-degree rivet as with a 90-degree one. A 78-degree countersink should also be used where a round-head rivet is inserted from the inside, because it takes less time for countersinking and less time to form the countersunk head, as shown at *J*, Fig. 1. It should be noted that when a 78-degree countersunk rivet is used, the outer skin should not be given a 78-degree flare, but should have a flare of approximately 85 degrees. The inner skin, or support, should be flared or countersunk to an angle of 90 degrees, the depth of the countersink being adjusted to fit the outer skin, which is flared to an angle of 85 degrees. This procedure has been found to give a tighter and better joint, as indicated at *M*, Fig. 1.

When the outer skin is over 0.064 inch in thickness and should therefore be countersunk, it is best to mark the corresponding holes on the inner skin with the words "not to be countersunk," in order to avoid mistakes. When supports for the thin metal or skin such as stringers on hulls and floats have to

be flared, a pneumatic or hydraulic squeezer like that shown at *P*, Fig. 3, should be used for the flaring operation.

It is recommended that a countersink enclosed in a housing, as shown at *K*, Fig. 1, be employed when countersinking operations are required. The countersink is held in the housing by a single ball bearing. It has a shank 1/4 inch in diameter for use with a pneumatic or electric drill. The depth of countersink is adjustable by inserting shims on the inside of the cover. To change the adjustment, the countersink must be disassembled for adding or removing the shims. This method of adjustment is more dependable than an outside adjustment.

Usually countersinks are required only for 3/32-, 1/8-, and 5/32-inch diameter holes. The depth of the countersink is determined by the diameter of the hole to be countersunk. The size of the countersinks is the same in all cases, only the pilot being changed to correspond to the size of the hole. To obtain smooth countersunk holes, the countersinking tool should be used with a slow-speed drill, operating at approximately 300 R.P.M.

Procedure in Drilling Holes

Holes in the thin metal or skin will be enlarged by flaring, and should therefore be drilled slightly under size. The following drill sizes are recommended for flared holes in the skin material for hulls, floats, etc.: For rivets 1/8 inch in diameter, a No. 30 drill; for rivets 5/32 inch in diameter, a No. 22 drill; for rivets 3/16 inch in diameter, a No. 13 drill.

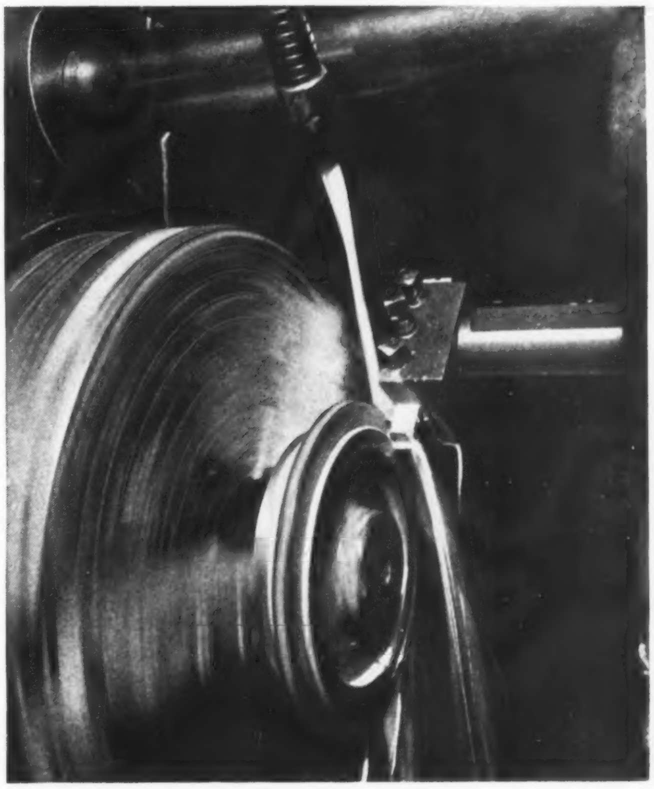
When holes are drilled in supports such as arches, frames, etc., and the skin is fitted on these members and drilled from the inside through the holes in the support, it is recommended that the holes in the support be drilled with a No. 31 drill, and finished with a No. 30 drill for a 1/8-inch rivet, or with a No. 22 drill for a 5/32-inch rivet when the skin is fitted.

Whenever possible, it is preferable to produce the holes by punching instead of drilling because of the saving in time. In many cases, when standard rivet spacings are used, six to twelve holes can be punched at one time. The holes must be punched under size and drilled to full size on assembly. For drilling holes, high speeds—at least 3000 R.P.M.—should be used.

In the production of flat hull and wing skins, several pieces of skin of the same thickness and size can be drilled at the same time. The sheets are stacked and clamped to a table, so that they can be drilled simultaneously by an electric or pneumatic drill, which is mounted on a free moving carriage attached to the table, as shown at *R*, Fig. 2. Thus the drill can be moved rapidly over the work instead of moving the work under the drill.

* * *

During November, 1938, the United States exported engine lathes to a value of $673,000; turret lathes, $473,000; gear-cutting machines, $212,000; internal grinding machines, $237,000; planers and shapers, $194,000; milling machines, $1,295,000; and automatic screw machines, $434,000.



Using a Haynes Stellite J-metal Tool for Turning a Gear Blank Made from Low-alloy High-strength Steel. The Gear Blank is Approximately 7 1/2 Inches in Diameter, with a Brinell Hardness of 240. The Surface Speed for Turning is 106 Feet per Minute; the Feed, 0.010 Inch per Revolution; and the Depth of Cut, 3/4 Inch

The Internal Grinding of

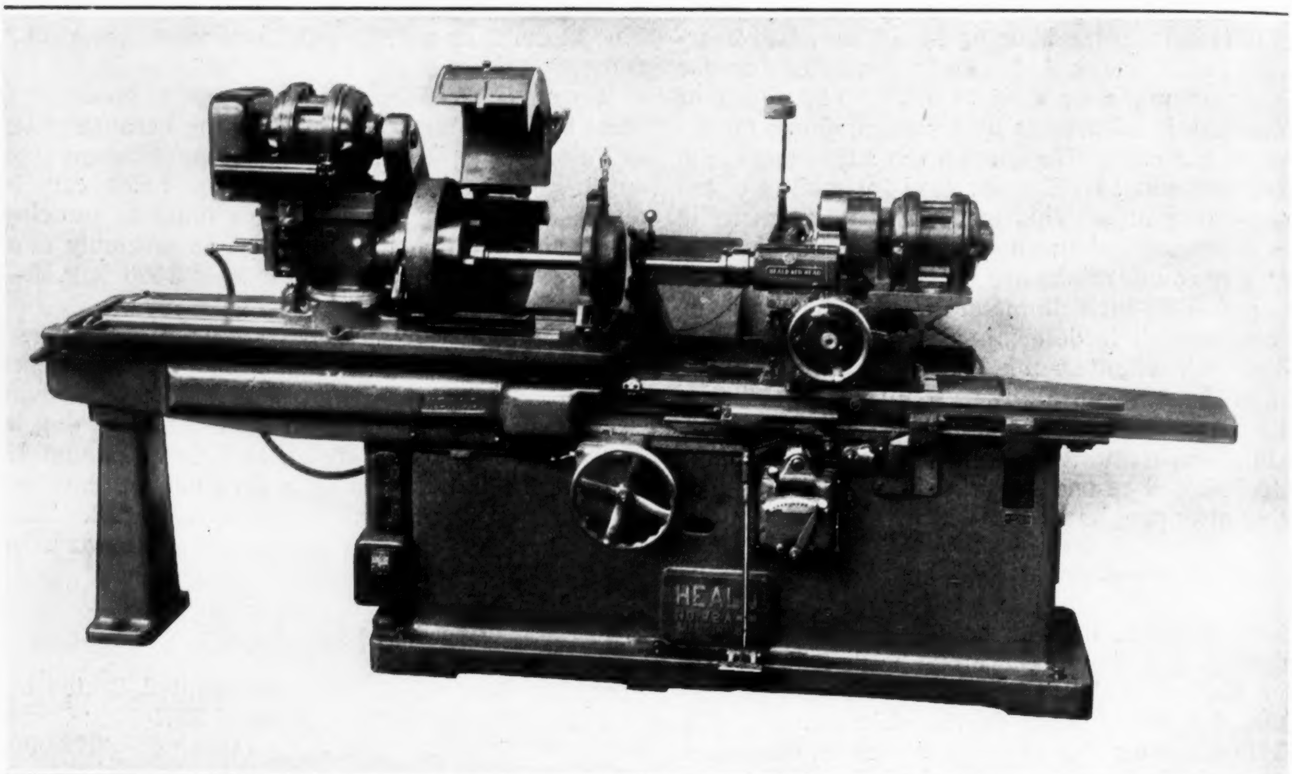


Fig. 1. Standard Heald Internal Grinding Machine Equipped with an Extended Bridge, Swivel-plate, and Steadyrest for Grinding Airplane Shock Strut Cylinders

STANDARD machine tools can often be adapted to work that is beyond their normal capacity by the provision of a longer table, a special tool-head, or some other member of modified design. In a number of instances, the Heald Machine Co., Worcester, Mass., has equipped standard internal grinding machines with an extended bridge under the work-head. This adapts the machines for finishing cylinders or sleeves considerably longer than could ordinarily be accommodated.

The No. 72A-5 long-base internal grinding machine illustrated in Fig. 1 is fitted with an extended bridge, supported at the outer end by a cast-iron pillar. Mounted on the bridge is a swivel-plate which is adjustable for alignment. On top of the swivel-plate is a work-head and also a steadyrest, both of which are free to slide on the swivel-plate to suit work of different lengths.

Machines of this construction have been built for grinding airplane shock strut cylinders having bores ranging from 2 inches in diameter by 12 inches in length up to 5 inches in diameter by 25 inches in length. The extended bridge construction, however, does not limit the machines to finishing strut cylinders or other long work, because the steadyrest can be easily removed for handling shorter work, and the work-head moved

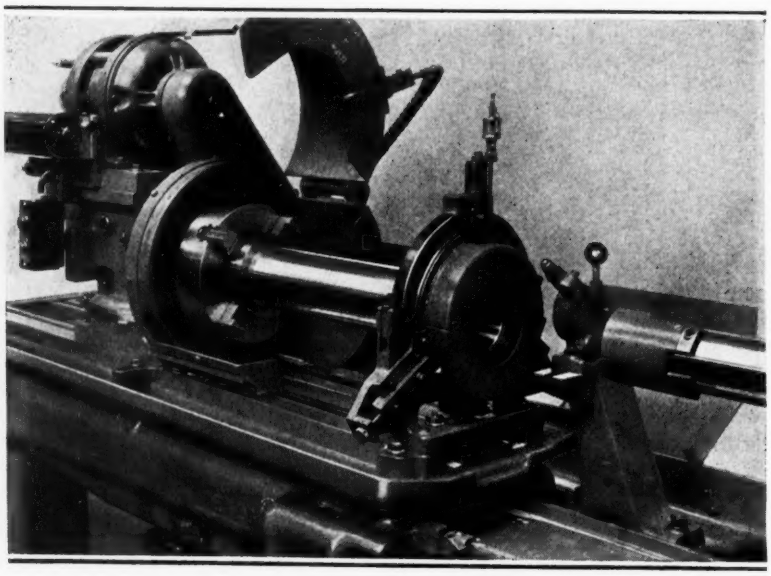


Fig. 2. Close-up View of an Internal Grinding Operation on an Airplane Shock Strut Cylinder, Showing Method of Supporting and Driving the Work

Unusually Long Work

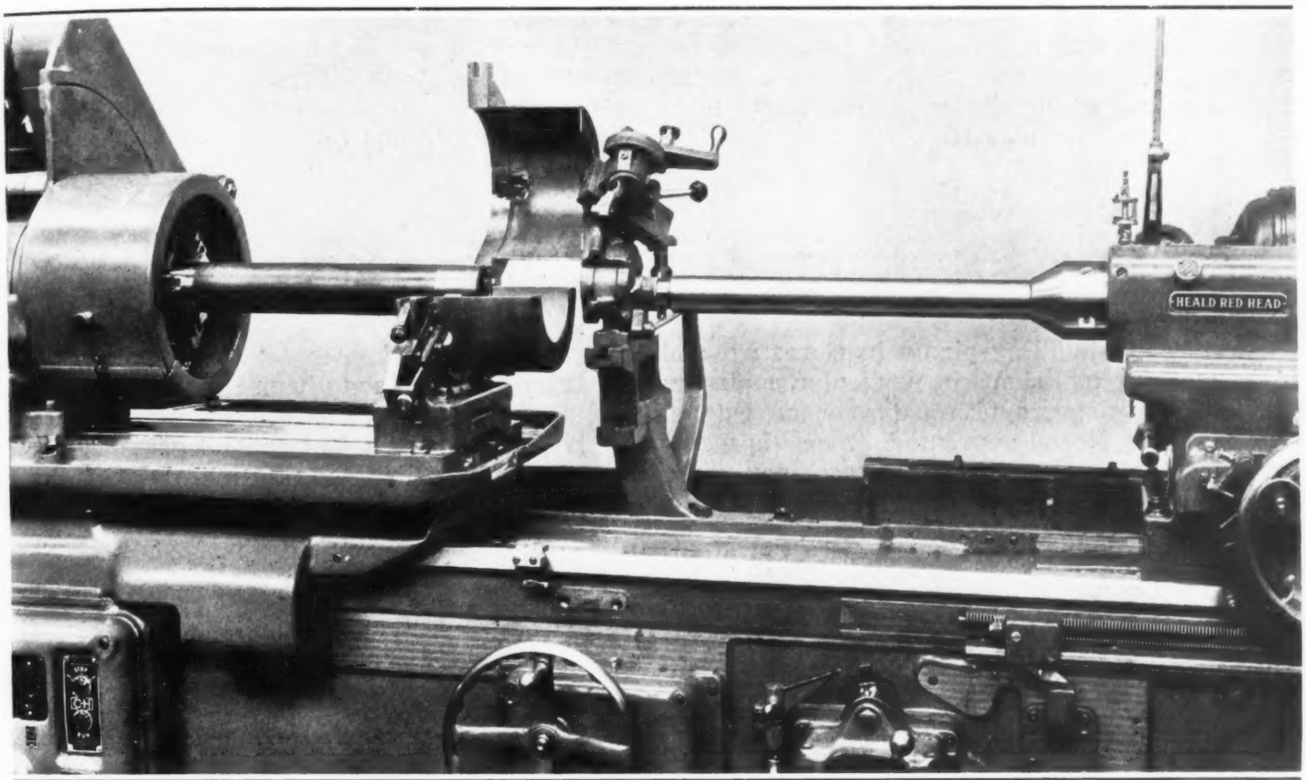


Fig. 3. Grinding a Gun Recoil Cylinder Having a Straight Bore over 2 Feet Long, a Taper Seat, and a Curved Surface Joining the Two, with a Cone-pointed Wheel

to its normal position at the front of the bridge. All sizes of cylinders ground in these machines are held at one end by a four-jaw chuck attached to the work-head, as shown in Fig. 2, and are supported at the other end by means of the steadyrest. The cylinders are not held directly in the jaws of either the chuck or the steadyrest, but indirectly through the use of ring adapters, screwed on the cylinder at each end. Both adapters are of the same diameter, so that the cylinders can be reversed in the machine for grinding from both ends without the necessity of changing the adapters.

Another operation that can be conveniently performed in the same type of machine equipped with an extended bridge is the grinding of the bearing hole in the flange end of a crankshaft. A typical operation of this kind is shown in Fig. 4. It consists of grinding a blind hole to a diameter of 1.5743 inches in the end of the crankshaft. The work is supported at this end in a steadyrest, and is driven from the opposite end by a three-jaw chuck which grips a main bearing surface. Both the work-head and steadyrest are mounted on a swivel-plate on the extended bridge of the machine.

Gun recoil cylinders are being ground on a Heald No. 74 internal grinding machine provided with an extended bridge which adapts the machine for fin-

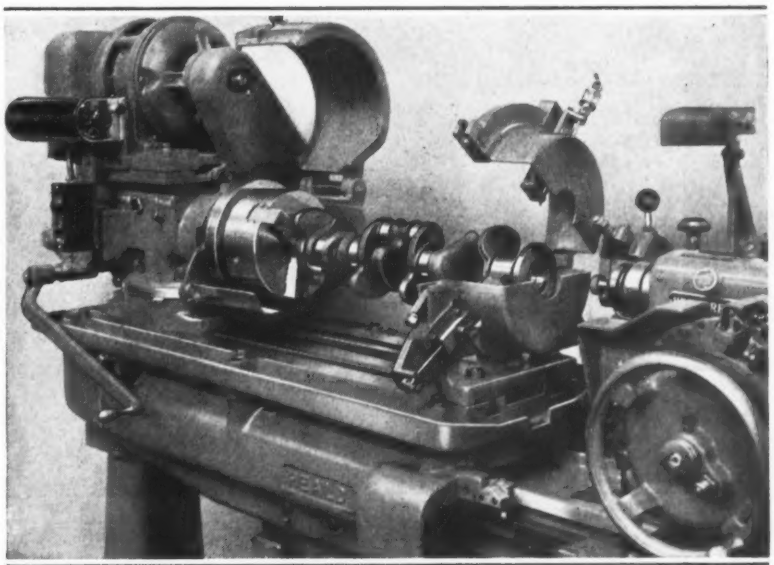


Fig. 4. Grinding a Blind Hole in the Flange End of a Crankshaft on a Regular Internal Grinding Machine Equipped with an Extended Bridge and a Steadyrest

ishing bores ranging from 2.55 inches inside diameter by 24.5 inches in length up to 5.9 inches in diameter by 23.6 inches in length. These cylinders are made of nickel steel. The machine is built with an extended base 105 inches long, in addition to the extended bridge. The bridge of this machine is also provided with a swivel-plate for holding the work-head and steadyrest, and there is a special grinding wheel truing device, a handwheel table feed, and a positive table stop.

The gun cylinder shown being ground in this machine in Fig. 3 has a straight bore 2.55 inches in diameter by 24.5 inches long. A 90-degree taper seat is ground at the inner end of this bore and also a curve of 0.4 inch radius to connect the straight bore with the taper seat.

A special cone-pointed grinding wheel is used. The wheel-truing device trues the periphery of the wheel in the regular manner, and, in addition, trues the angular face and rounded corner of the wheel.

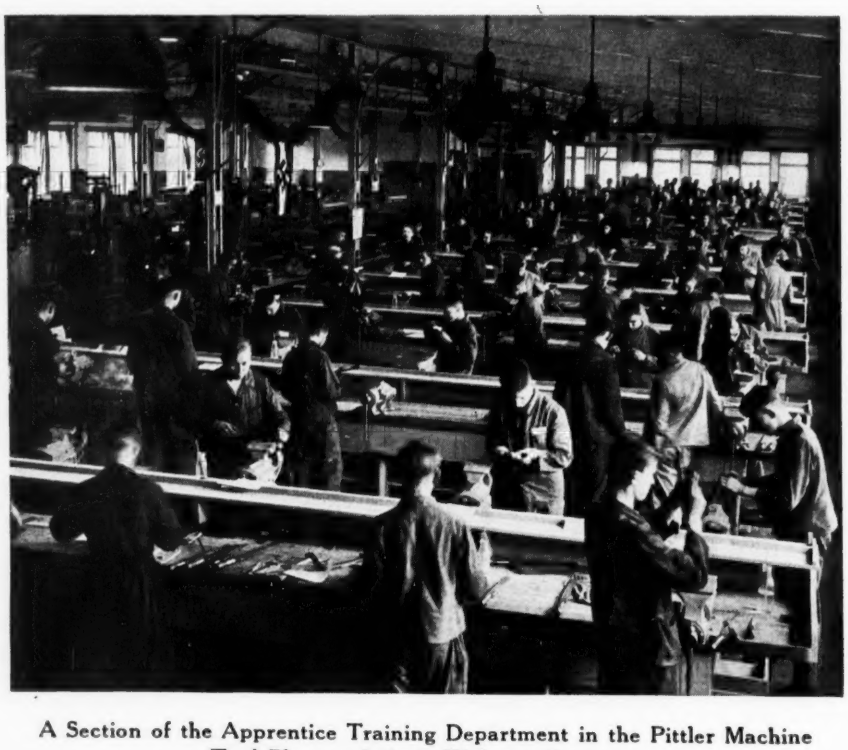
Apprentice Training in Germany

THE machine-building plants in Germany, and the machine tool shops in particular, maintain very highly developed apprentice systems. One of these highly developed apprentice schools is maintained by the Pittler Werkzeugmaschinenfabrik A.G., Leipzig-Wahren, where approximately 175 apprentices are being trained regularly.

The apprentice courses in German plants differ somewhat according to the plan of training adopted. In some, the course is three years; in others, four years. Generally, the boys are first placed in a training shop and later in the production departments of the plant. In a few instances, however, they are placed in the production departments at the beginning of their training.

The complete apprentice training in the Pittler plant comprises four years, with two years in the apprentice training shop and two years in the production departments. The boys also receive regular school training in subjects pertaining to machine shop practice.

Great care is taken in selecting the right boys for training, in order to insure that only boys with real aptitude for mechanical work are put through the training courses. The present great activity in all machinery industries in Germany has, of course, greatly stimulated the efforts made in the direction of apprentice training.



A Section of the Apprentice Training Department in the Pittler Machine Tool Plant at Leipzig-Wahren, Germany

* * *

Meeting of Rockford Tool Engineers

The Rockford Chapter of the American Society of Tool Engineers met January 13 at the Hotel Faust in Rockford, Ill. At this meeting, George Mencke, sales manager of the Vascoloy-Ramet Corporation, North Chicago, Ill., spoke on "The Machinability of Metals." In connection with the meeting, there was an exhibition of the products of numerous companies in the tool and accessories field, about a dozen firms being represented.

The next meeting of the Rockford Chapter of the Society will be held February 9, at which time the speakers will be Walter Wagner, national president of the American Society of Tool Engineers and master mechanic of the Lincoln Motor Co., Detroit, Mich., and Erik Oberg, Editor of MACHINERY, New York. The subject of Mr. Oberg's address will be "The Machine Before the Court of Public Opinion."

* * *

According to figures published by the Industrial Machinery Division of the Bureau of Foreign and Domestic Commerce, the total machinery imports of Canada in 1937 amounted to $46,150,000, of which $40,080,000 worth came from the United States, $4,690,000 worth from the United Kingdom, and $806,000 worth from Germany. Of these imports, metal-working machinery accounted for $7,425,000.

"Distorting" Pantograph for Engraving and Drawing

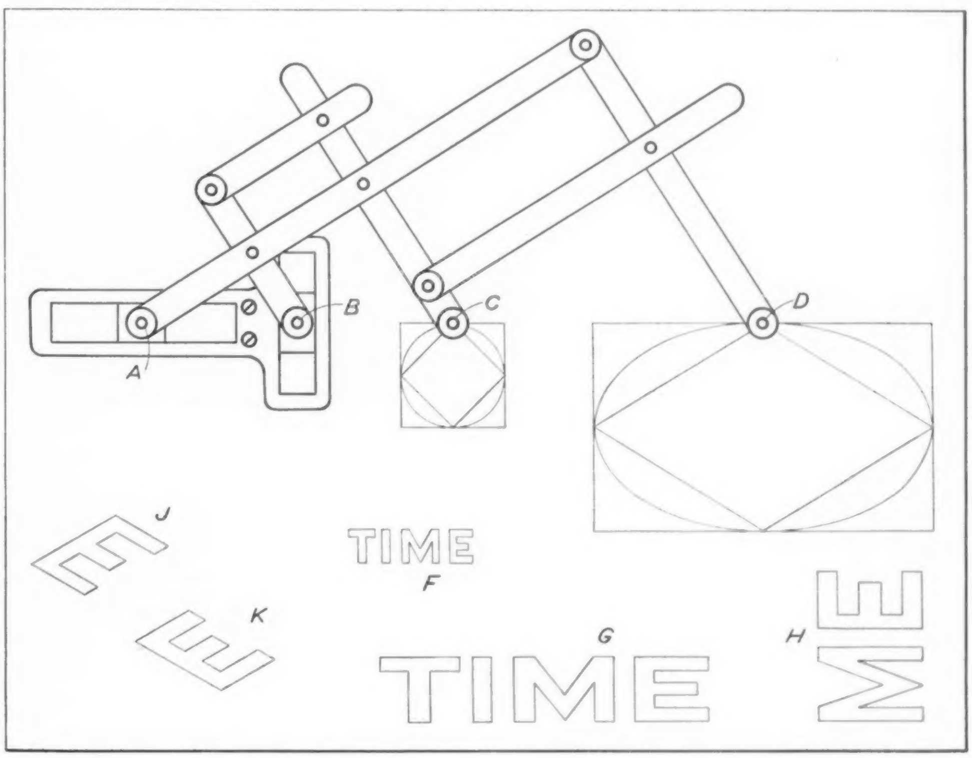
By A. A. NEFF

Accuracy in proportioning the copy of an outline is the prime requisite of the ordinary pantograph. There are instances, however, where it is desirable to produce a copy that differs in its proportions from the original, the outline being distorted in a definite way. A pantograph for producing such a definitely distorted copy is shown in the accompanying illustration. As the combination of links is largely the same as in the conventional pantograph, the description refers mainly to those features pertaining to the distorting mechanism.

Instead of being pivoted at one fixed point, like the usual instrument, this one is carried at two points *A* and *B*, which are free to move in a restricted manner. The movements of points *A* and *B* are constrained by slots in a guide which is fastened to the table. Sliding in these slots, which are perpendicular to each other, are two blocks, to which *A* and *B* are pivoted. This guide can be reversed on the points *A* and *B*, and it can be set at any angle for producing the desired result.

For enlarging, let us say, *C* is the tracing point, and *D* is the scriber. With the arrangement set up as shown, all horizontal enlargements are made in the ratio of *DB* to *BC*, while vertical enlargements are in the ratio of *DA* to *AC*.

The results obtained are illustrated with the letters of the word "Time." The original, which is assumed as of normal proportions, is shown at *F*. When this original is placed under the tracer *C* to read in the horizontal direction, the resulting letters are elongated as shown at *G*. When the original is placed to read vertically, the effect shown at *H* is obtained. When placed diagonally, the resulting form is as shown at *J* or *K*. The same varied results can be had by keeping the original in the horizontal position and swinging the guide to the required position.



Pantograph for Producing Copies that are Distorted Either Horizontally or Vertically, as at G and H, or Diagonally, as Shown at J and K

* * *

The exports of machine tools and power-driven metal-working machinery from the United States in November, 1938, amounted to $8,045,000, which represented an increase of 34 per cent over the exports in November, 1937, valued at about $5,990,000.

Cooperation between Industry and Public Schools

An interesting example of cooperation between industry and the public schools is found in Baltimore, Md., where the Glenn L. Martin Co. has offered its services to the educational authorities of that city in helping shop men and high-school students to prepare themselves for industrial work. Twenty representatives of the Martin engineering and tool design departments act as instructors Saturday mornings at the city's Polytechnic Institute conducting courses in blueprint reading. More than 400 students are enrolled.

It is believed by the Martin company that if enough manufacturing plants would cooperate in this way with the public school authorities, the shortage of skilled and trained men might be much reduced. Not only would men now unable to find employment because of insufficient training be helped to become self-supporting, but thousands of young men would have an opportunity to gain such training as would enable them to get a start in industry.

* * *

The average family using electricity in the home pays $5.60 a year, or nearly 50 cents a month, in taxes concealed in its electric light bill. While the average consumer is paying no more to the electric companies for electric current today than he did six years ago, the taxes paid by the companies have increased 40 per cent. Obviously, if these taxes had not been imposed, electric current rates could have been that much lower.

Formulas and Tables for Determining

Elimination of Waste by Cutting Material to Exact Lengths Before Bending Saved $2500 a Year in One Department Employing Thirty Men

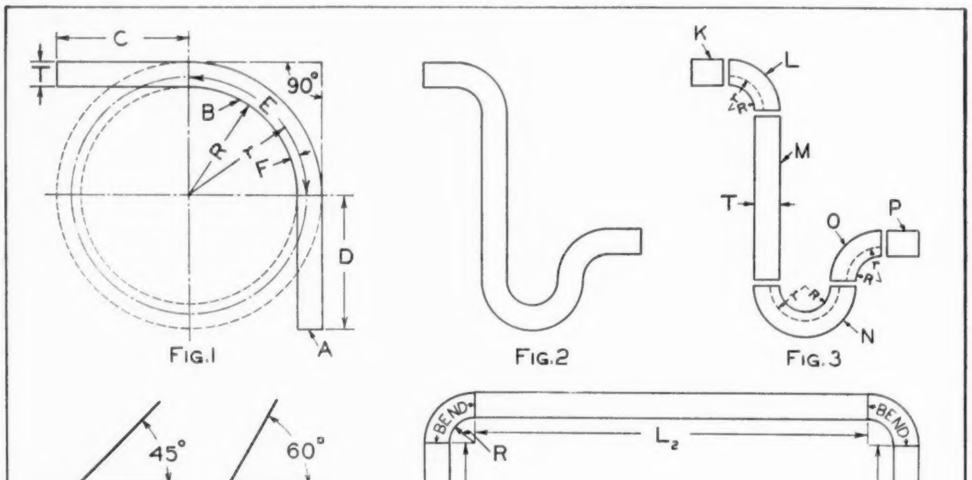
A GREAT many different methods are used in determining the length of material required for parts that are to be bent to various shapes and sizes. Most of the methods are the result of a trial and error process. The usual "vest pocket" information is retained by the individual making the part, with the result that each workman who handles the same part will require a different size of material.

It appears to be the usual custom to provide a piece of sufficient length and then trim off the excess material after the part has been made according to specifications. This causes many errors and a considerable waste of material, as the predetermined length is usually only approximate. The number of errors increases when a variety of different materials are used in the course of a day's work, since the individual workman usually has one method that he employs in estimating the required length for all kinds of material.

In order to eliminate this waste of material and time, a standard method of calculating lengths has been established at the plant of the Westinghouse Electric & Mfg. Co., and the correct length, as calculated to the nearest 1/64 inch, is now ordered from the shearing department. To avoid repetition of calculations, the size required is listed on a cost record file and is typed on each repeat order as a matter of routine. The time study man calculates all lengths where bending operations are performed. Through the application of this system, the saving in material costs in one department having a group of thirty men has been approximately $2500 per year. In the construction of new dies, the same procedure is followed by the tool designer, who specifies the correct size for the blank to be used in developing bending tools, thus avoiding the usual errors in the blanking die caused by the trial and error method.

The formulas given in this article for determining the lengths of parts for bending apply to metal parts made from ferrous and non-ferrous material bent on simple tools or on the bench, where the limits specified are plus or minus 1/64 inch. Separate charts have been made up to cover the different types of material most commonly used, but no attempt has been made to distinguish between materials other than by general terms, since the variations in developed lengths would come within the tolerance specified in all cases.

The length of a piece of material for a part that is to have one or more bends is determined by calculating the lengths required for the bends and adding them to the lengths of the straight portions. For example, the length of the piece of material required for the part shown at *A*, Fig. 1, is determined by adding the length of the piece required for the circular section *B* to the lengths *C* and *D* of the straight sections. The length of the material required for the circular section *B* is calculated as the length of the arc *E*. The length of arc *E* depends upon the radius *r*, which is determined by the dimension *F*. Dimension *F* equals the thickness of



Figs. 1 to 5. Diagrams Illustrating Methods Used in Calculating Lengths of Material Required to Make Bent Parts

Length of Parts Before Bending

By T. P. HEAPS and S. C. McDOWELL
Time Study Department
Westinghouse Electric & Mfg. Co.
East Pittsburgh, Pa.

the stock multiplied by a factor f obtained by experiments. Factor f varies for the different kinds and conditions of materials used.

From the illustration, it will be obvious that the dimension F equals the amount that must be added to the radius R of the inside of the bend, in order to find the radius r of the arc E which is equal in length to the piece of stock or material required for the bend section B; in other words, arc E equals the length of section B before bending. The values of f selected for different materials after conducting extensive experiments are as follows: For soft materials, $f = 0.35$; for half-hard materials, $f = 0.40$; and for hard materials, $f = 0.45$. These factors were used to determine the developed lengths of bend sections given in Tables 1, 2, and 3.

Referring to Fig. 1, let it be assumed that the piece A is made from soft copper, 0.25 inch thick, and that this piece is required to be bent to a right angle as shown, with the radius R of the inside of the bend equal to 1 inch. Thus we have $T = 0.25$ inch; $R = 1$ inch; and $F = T \times f = 0.25 \times 0.35 = 0.0875$ inch, the value 0.35 used in this case having been selected as the factor f for soft materials. Theoretically, $T \times 0.35$ equals the amount that must be added to the radius R to obtain the radius r of the arc E which, as previously stated, represents the length of the material required for the bend section B.

From inspection of the diagram Fig. 1, it will be obvious that the length of arc E can be found by the simple formula

$$E = \frac{(2R + 2F) \times \pi}{4}$$

Table 1. Developed Length of Material Required for 90-Degree Bends in Soft Copper and Soft Brass*

Radius R of Bend, Inches	Thickness T of Material, Inch												
	1/64	1/32	3/64	1/16	5/64	3/32	1/8	5/32	3/16	7/32	1/4	9/32	5/16
1/64	0.033	0.041	0.050	0.058	0.067	0.076	0.093	0.110	0.127	0.144	0.162	0.179	0.196
1/32	0.058	0.066	0.075	0.083	0.092	0.101	0.118	0.135	0.152	0.169	0.187	0.204	0.221
3/64	0.083	0.091	0.100	0.108	0.117	0.126	0.143	0.160	0.177	0.194	0.212	0.229	0.246
1/16	0.107	0.115	0.124	0.132	0.141	0.150	0.167	0.184	0.201	0.218	0.236	0.253	0.270
5/64	0.132	0.140	0.149	0.157	0.166	0.175	0.192	0.209	0.226	0.243	0.261	0.278	0.295
3/32	0.156	0.164	0.173	0.181	0.190	0.199	0.216	0.233	0.250	0.267	0.285	0.302	0.319
7/64	0.180	0.188	0.197	0.205	0.214	0.223	0.240	0.257	0.274	0.291	0.309	0.326	0.343
1/8	0.205	0.213	0.222	0.230	0.239	0.248	0.265	0.282	0.299	0.316	0.334	0.351	0.368
9/64	0.230	0.238	0.247	0.255	0.264	0.273	0.290	0.307	0.324	0.341	0.359	0.376	0.393
5/32	0.254	0.262	0.271	0.279	0.288	0.297	0.314	0.331	0.348	0.365	0.383	0.400	0.417
3/16	0.303	0.311	0.320	0.328	0.337	0.346	0.363	0.380	0.397	0.414	0.432	0.449	0.466
7/32	0.353	0.361	0.370	0.378	0.387	0.396	0.413	0.430	0.447	0.464	0.482	0.499	0.516
1/4	0.401	0.409	0.418	0.426	0.435	0.444	0.461	0.478	0.495	0.512	0.530	0.547	0.564
9/32	0.450	0.458	0.467	0.475	0.484	0.493	0.510	0.527	0.544	0.561	0.579	0.596	0.613
5/16	0.499	0.507	0.516	0.524	0.533	0.542	0.559	0.576	0.593	0.610	0.628	0.645	0.662
11/32	0.549	0.557	0.566	0.574	0.583	0.592	0.609	0.626	0.643	0.660	0.678	0.695	0.712
3/8	0.598	0.606	0.615	0.623	0.632	0.641	0.658	0.675	0.692	0.709	0.727	0.744	0.761
13/32	0.646	0.654	0.663	0.671	0.680	0.689	0.706	0.723	0.740	0.757	0.775	0.792	0.809
7/16	0.695	0.703	0.712	0.720	0.729	0.738	0.755	0.772	0.789	0.806	0.824	0.841	0.858
15/32	0.734	0.742	0.751	0.759	0.768	0 777	0.794	0.811	0.828	0.845	0.863	0.880	0.897
1/2	0.794	0.802	0.811	0.819	0.828	0.837	0.854	0.871	0.888	0.905	0.923	0.940	0.957
9/16	0.892	0.900	0.909	0.917	0.926	0.935	0.952	0.969	0.986	1.003	1.021	1.038	1.055
5/8	0.990	0.998	1.007	1.015	1.024	1.033	1.050	1.067	1.084	1.101	1 119	1.136	1.153
11/16	1.089	1.097	1.106	1.114	1.123	1.132	1.149	1.166	1.183	1.200	1.218	1.235	1.252
3/4	1.187	1.195	1.204	1.212	1.221	1.230	1.247	1.264	1.281	1.298	1.316	1 333	1.350
13/16	1.286	1.294	1.303	1.311	1.320	1.329	1.346	1.363	1.380	1.397	1.415	1.432	1.449
7/8	1.384	1.392	1.401	1.409	1.418	1.427	1.444	1.461	1.478	1.495	1.513	1.530	1.547
15/16	1.481	1.489	1.498	1.506	1.515	1.524	1.541	1.558	1.575	1.592	1.610	1.627	1.644
1	1.580	1.588	1.597	1.605	1.614	1.623	1.640	1.657	1.674	1.691	1.709	1.726	1.743
1 1/16	1.678	1.686	1.695	1.703	1.712	1.721	1.738	1.755	1.772	1.789	1.807	1.824	1.841
1 1/8	1.777	1.785	1.794	1.802	1.811	1.820	1.837	1.854	1.871	1.888	1.906	1.923	1.940
1 3/16	1.875	1.883	1.892	1.900	1.909	1.918	1.935	1.952	1.969	1.986	2.004	2.021	2.038
1 1/4	1.972	1.980	1.989	1.997	2.006	2.015	2.032	2.049	2.066	2.083	2.101	2.118	2 135

*Developed lengths of 90-degree bends given in this table $= 0.55T + 1.57R$. The developed length of any bend other than 90 degrees $=$ value in table $\times \dfrac{\text{angle of bend in degrees}}{90}$

Table 2. Developed Length of Material Required for 90-Degree Bends in Half-Hard Sheet Copper, Half-Hard Brass, and Soft Steel*

Radius R of Bend, Inches	Thickness T of Material, Inch												
	1/64	1/32	3/64	1/16	5/64	3/32	1/8	5/32	3/16	7/32	1/4	9/32	5/16
1/64	0.034	0.044	0.054	0.064	0.074	0.084	0.104	0.124	0.144	0.164	0.184	0.204	0.224
1/32	0.059	0.069	0.079	0.089	0.099	0.109	0.129	0.149	0.169	0.189	0.209	0.229	0.249
3/64	0.084	0.094	0.104	0.114	0.124	0.134	0.154	0.174	0.194	0.214	0.234	0.254	0.274
1/16	0.108	0.118	0.128	0.138	0.148	0.158	0.178	0.198	0.218	0.238	0.258	0.278	0.298
5/64	0.133	0.143	0.153	0.163	0.173	0.183	0.203	0.223	0.243	0.263	0.283	0.303	0.323
3/32	0.157	0.167	0.177	0.187	0.197	0.207	0.227	0.247	0.267	0.287	0.307	0.327	0.347
7/64	0.181	0.191	0.201	0.211	0.221	0.231	0.251	0.271	0.291	0.311	0.331	0.351	0.371
1/8	0.206	0.216	0.226	0.236	0.246	0.256	0.276	0.296	0.316	0.336	0.356	0.376	0.396
9/64	0.231	0.241	0.251	0.261	0.271	0.281	0.301	0.321	0.341	0.361	0.381	0.401	0.421
5/32	0.255	0.265	0.275	0.285	0.295	0.305	0.325	0.345	0.365	0.385	0.405	0.425	0.445
3/16	0.304	0.314	0.324	0.334	0.344	0.354	0.374	0.394	0.414	0.434	0.454	0.474	0.494
7/32	0.354	0.364	0.374	0.384	0.394	0.404	0.424	0.444	0.464	0.484	0.504	0.524	0.544
1/4	0.402	0.412	0.422	0.432	0.442	0.452	0.472	0.492	0.512	0.532	0.552	0.572	0.592
9/32	0.451	0.461	0.471	0.481	0.491	0.501	0.521	0.541	0.561	0.581	0.601	0.621	0.641
5/16	0.500	0.510	0.520	0.530	0.540	0.550	0.570	0.590	0.610	0.630	0.650	0.670	0.690
11/32	0.550	0.560	0.570	0.580	0.590	0.600	0.620	0.640	0.660	0.680	0.700	0.720	0.740
3/8	0.599	0.609	0.619	0.629	0.639	0.649	0.669	0.689	0.709	0.729	0.749	0.769	0.789
13/32	0.647	0.657	0.667	0.677	0.687	0.697	0.717	0.737	0.757	0.777	0.797	0.817	0.837
7/16	0.696	0.706	0.716	0.726	0.736	0.746	0.766	0.786	0.806	0.826	0.846	0.866	0.886
15/32	0.735	0.745	0.755	0.765	0.775	0.785	0.805	0.825	0.845	0.865	0.885	0.905	0.925
1/2	0.795	0.805	0.815	0.825	0.835	0.845	0.865	0.885	0.905	0.925	0.945	0.965	0.985
9/16	0.893	0.903	0.913	0.923	0.933	0.943	0.963	0.983	1.003	1.023	1.043	1.063	1.083
5/8	0.991	1.001	1.011	1.021	1.031	1.041	1.061	1.081	1.101	1.121	1.141	1.161	1.181
11/16	1.090	1.100	1.110	1.120	1.130	1.140	1.160	1.180	1.200	1.220	1.240	1.260	1.280
3/4	1.188	1.198	1.208	1.218	1.228	1.238	1.258	1.278	1.298	1.318	1.338	1.358	1.378
13/16	1.287	1.297	1.307	1.317	1.327	1.337	1.357	1.377	1.397	1.417	1.437	1.457	1.477
7/8	1.385	1.395	1.405	1.415	1.425	1.435	1.455	1.475	1.495	1.515	1.535	1.555	1.575
15/16	1.482	1.492	1.502	1.512	1.522	1.532	1.552	1.572	1.592	1.612	1.632	1.652	1.672
1	1.581	1.591	1.601	1.611	1.621	1.631	1.651	1.671	1.691	1.711	1.731	1.751	1.771
1 1/16	1.679	1.689	1.699	1.709	1.719	1.729	1.749	1.769	1.789	1.809	1.829	1.849	1.869
1 1/8	1.778	1.788	1.798	1.808	1.818	1.828	1.848	1.868	1.888	1.908	1.928	1.948	1.968
1 3/16	1.876	1.886	1.896	1.906	1.916	1.926	1.946	1.966	1.986	2.006	2.026	2.046	2.066
1 1/4	1.973	1.983	1.993	2.003	2.013	2.023	2.043	2.063	2.083	2.103	2.123	2.143	2.163

*Developed lengths of 90-degree bends given in this table $= 0.64T + 1.57R$. The developed length of any bend other than 90 degrees $=$ value in table $\times \dfrac{\text{angle of bend in degrees}}{90}$

Substituting numerical values in this formula, we have

$$E = \frac{(2 + 0.175) \times 3.1416}{4} = 1.708$$

It will be noted that 1.708 corresponds closely with the value given in Table 1. As the straight portions C and D of part A are each 1.25 inches long, the total length of the material required for the bent part $A = 2.50 + 1.708 = 4.208$ inches, say 4 13/64 inches. Usually, the drawing is marked: "Shear 4 13/64 inches."

The simplified formula used in computing the values given in Table 1 for a developed length of a 90-degree bend, which is represented by arc E is:

$$E = 0.55T + 1.57R$$

as given at the bottom of the table.

This formula is derived as follows: Referring to Fig. 1, arc $E = 1/4$ of the circumference of a circle having a radius r. As $r = F + R$, we have the circumference of a circle of radius r equal to $(2F + 2R) \times 3.1416$. Therefore, the length of arc E, which is 1/4 of the circumference, equals

$$E = (2F + 2R) \times 0.7854 = (F + R) \times 1.57, \text{ approximately}$$

Now as $F = T \times$ factor f, we have

$$E = (F + R) \times 1.57 = (f \times T) \times 1.57 + 1.57R$$

Now as f for this case $= 0.35$, we have,

$$E = (0.35T \times 1.57) + 1.57R = 0.55T + 1.57R$$

As the values of factor f used in the formulas given in Tables 1, 2, and 3 are 0.35, 0.40, and 0.45, respectively, the equations for the tables are as follows:

Table 1:
$$E = (0.35T \times 1.57) + 1.57R = 0.55T + 1.57R$$

Table 2:
$$E = (0.40T \times 1.57) + 1.57R = 0.64T + 1.57R$$

Table 3:
$$E = (0.45T \times 1.57) + 1.57R = 0.71T + 1.57R$$

In Fig. 2 is shown a completed part having three bends. Fig. 3 shows the same piece broken up into its straight and bent sections. The length of the straight piece of stock required to make this part equals the sum of the straight sections K, M, and P plus the lengths required to make the bent sections L, N, and O. The lengths of the bent sections can be obtained from one of the three tables, using the table that gives the value for the kind of material from which the part is made. If the radius R is within the range of the table, the lengths of the 90-degree bends L and O can be found directly.

Table 3. Developed Length of Material Required for 90-Degree Bends in Hard Copper, Bronze, Cold-Rolled Steel, and Spring Steel*

Radius R of Bend, Inches	Thickness T of Material, Inch												
	1/64	1/32	3/64	1/16	5/64	3/32	1/8	5/32	3/16	7/32	1/4	9/32	5/16
1/64	0.035	0.046	0.057	0.068	0.079	0.091	0.113	0.135	0.157	0.179	0.202	0.224	0.246
1/32	0.060	0.071	0.082	0.093	0.104	0.116	0.138	0.160	0.182	0.204	0.227	0.249	0.271
3/64	0.085	0.096	0.107	0.118	0.129	0.141	0.163	0.185	0.207	0.229	0.252	0.274	0.296
1/16	0.109	0.120	0.131	0.142	0.153	0.165	0.187	0.209	0.231	0.253	0.276	0.298	0.320
5/64	0.134	0.145	0.156	0.167	0.178	0.190	0.212	0.234	0.256	0.278	0.301	0.323	0.345
3/32	0.158	0.169	0.180	0.191	0.202	0.214	0.236	0.258	0.280	0.302	0.325	0.347	0.369
7/64	0.182	0.193	0.204	0.215	0.226	0.238	0.260	0.282	0.304	0.326	0.349	0.371	0.393
1/8	0.207	0.218	0.229	0.240	0.251	0.263	0.285	0.307	0.329	0.351	0.374	0.396	0.418
9/64	0.232	0.243	0.254	0.265	0.276	0.288	0.310	0.332	0.354	0.376	0.399	0.421	0.443
5/32	0.256	0.267	0.278	0.289	0.300	0.312	0.334	0.356	0.378	0.400	0.423	0.445	0.467
3/16	0.305	0.316	0.327	0.338	0.349	0.361	0.383	0.405	0.427	0.449	0.472	0.494	0.516
7/32	0.355	0.366	0.377	0.388	0.399	0.411	0.433	0.455	0.477	0.499	0.522	0.544	0.566
1/4	0.403	0.414	0.425	0.436	0.447	0.459	0.481	0.503	0.525	0.547	0.570	0.592	0.614
9/32	0.452	0.463	0.474	0.485	0.496	0.508	0.530	0.552	0.574	0.596	0.619	0.641	0.663
5/16	0.501	0.512	0.523	0.534	0.545	0.557	0.579	0.601	0.623	0.645	0.668	0.690	0.712
11/32	0.551	0.562	0.573	0.584	0.595	0.607	0.629	0.651	0.673	0.695	0.718	0.740	0.762
3/8	0.600	0.611	0.622	0.633	0.644	0.656	0.678	0.700	0.722	0.744	0.767	0.789	0.811
13/32	0.648	0.659	0.670	0.681	0.692	0.704	0.726	0.748	0.770	0.792	0.815	0.837	0.859
7/16	0.697	0.708	0.719	0.730	0.741	0.753	0.775	0.797	0.819	0.841	0.864	0.886	0.908
15/32	0.736	0.747	0.758	0.769	0.780	0.792	0.814	0.836	0.858	0.880	0.903	0.925	0.947
1/2	0.796	0.807	0.818	0.829	0.840	0.852	0.874	0.896	0.918	0.940	0.963	0.985	1.007
9/16	0.894	0.905	0.916	0.927	0.938	0.950	0.972	0.994	1.016	1.038	1.061	1.083	1.105
5/8	0.992	1.003	1.014	1.025	1.036	1.048	1.070	1.092	1.114	1.136	1.159	1.181	1.203
11/16	1.091	1.102	1.113	1.124	1.135	1.147	1.169	1.191	1.213	1.235	1.258	1.280	1.302
3/4	1.189	1.200	1.211	1.222	1.233	1.245	1.267	1.289	1.311	1.333	1.356	1.378	1.400
13/16	1.288	1.299	1.310	1.321	1.332	1.344	1.366	1.388	1.410	1.432	1.455	1.477	1.499
7/8	1.386	1.397	1.408	1.419	1.430	1.442	1.464	1.486	1.508	1.530	1.553	1.575	1.597
15/16	1.483	1.494	1.505	1.516	1.527	1.539	1.561	1.583	1.605	1.627	1.650	1.672	1.694
1	1.582	1.593	1.604	1.615	1.626	1.638	1.660	1.682	1.704	1.726	1.749	1.771	1.793
1 1/16	1.680	1.691	1.702	1.713	1.724	1.736	1.758	1.780	1.802	1.824	1.847	1.869	1.891
1 1/8	1.779	1.790	1.801	1.812	1.823	1.835	1.857	1.879	1.901	1.923	1.946	1.968	1.990
1 3/16	1.877	1.888	1.899	1.910	1.921	1.933	1.955	1.977	1.999	2.021	2.044	2.066	2.088
1 1/4	1.974	1.985	1.996	2.007	2.018	2.030	2.052	2.074	2.096	2.118	2.141	2.163	2.185

*Developed lengths of 90-degree bends given in this table $= 0.71T + 1.57R$. The developed length of any bend other than 90 degrees $=$ value in table $\times \dfrac{\text{angle of bend in degrees}}{90}$

The length required for the 180-degree bend N is found by multiplying the length for a 90-degree bend by 2. When the required radius of the bend is not given in the table, the formulas in the table for the required material can be used in finding the lengths of material required for the bend sections. The dotted arcs shown in Fig. 3 which represent the lengths of the material required for the bend sections have their radii indicated as r. Attention is called to the fact that with a change in the direction of the bend, radius r is measured from the opposite side of the piece, the radius r always being on the inside of the bend.

When the piece to be bent has two or more bends of the same radius, it is, of course, only necessary to obtain the length required for one of the bends and multiply the result by the number of bends of the same radius. For example, the length of the material required for a piece having two bends as shown in Fig. 5 would equal $L_1 + L_2 + L_3 + 2$ times the length given in the table for a piece required to make the bend having the radius R.

In order to clarify a source of frequent mistakes in calculating the lengths of materials required for bent parts, reference is now made to Fig. 4. A piece bent as shown at G is ordinarily indicated by the included angle between the two sides, or 45 degrees; whereas, the bend is actually 180 degrees minus the 45-degree included angle, the bent-up end having passed through an arc of 135 degrees during the bending operation. Likewise, an angle of 135 degrees is actually a bend of 180 degrees minus 135 degrees, or 45 degrees.

Since the majority of bends made are 90 degrees, the values given in Tables 1, 2, and 3 are for 90-degree bends. These tables were made up to cover various size radii and material of the thicknesses most commonly used. When a bend other than 90 degrees is made, the charts can be used, a proportional amount of the value given in the chart being taken according to the angle of the bend. For example, in the case of a 60-degree bend, such as shown at I, Fig. 4, the value in the chart is multiplied by the fraction $60 \div 90$. If the bend indicated as 60 degrees is measured by the included angle, as shown at H, the angle of the bend is actually 180 degrees minus 60 degrees or 120 degrees, in which case the value for the 90-degree bend in the table would be multiplied by $120 \div 90$. Another method of indicating what is actually a 60-degree bend is shown at J.

The following examples will serve to illustrate the practical application of the accompanying tables to three different pieces. The material used for the piece shown in Fig. 7 is soft steel, 3/16 inch thick. To find the developed length of this piece from the

dimensions given, it is necessary to find the angle a. The length of the hypotenuse bc equals the radius R plus one-half the thickness of the material, or 0.594 inch. Then the cosine of angle $a = 0.500 \div 0.594 = 0.840$. The angle corresponding to this cosine equals 33 degrees, approximately. Now $d = R \times \tan 33$ deg. $= 0.500 \times 0.649 = 0.324$ and $L_1 = 1.500 - 0.324 = 1.176$ inches. From Table 2, we have the length of 3/16-inch thick material required for a 33-degree bend with a radius R of 0.500 inch on the inside of the material $= 0.905 \times (33 \div 90) = 0.33$ inch. The two bends, therefore, equal 2×0.33 or 0.66 inch. Thus the total developed length of the piece shown in Fig. 7 equals $1.176 + 1.176 + 0.66 = 3.012$ inches.

The bent piece shown in Fig. 8 is made from soft steel, 1/16 inch thick. To find the developed length of this piece, it is first necessary to find angle a of the bend. In the triangle having two sides A and B, side A equals $5/16 - 1/8 = 3/16$ inch. The sine of angle b opposite side A equals $3/16 \div 5/16 = 0.6000$. This sine corresponds to an angle of 37 degrees. Side B equals $5/16 \times \cos b = 0.313 \times \cos 0.798 = 0.249$. Therefore, the angle a of the bend equals 90 degrees minus 37 degrees equals 53 degrees.

Now the length of the straight section $L = 1.031 - (0.249 + 0.063 + 0.063) = 0.656$ inch. From Table 2, we find that the length of material required for the bend at the left end of the piece having a radius of 1/16 inch is $0.138 \times (180 \div 90) = 0.276$ inch; the bend at the opposite end having a radius R of 1/4 inch and an angle of 53 degrees equals $0.432 \times (53 \div 90) = 0.254$ inch. Thus the developed length of the piece shown in Fig. 8 equals $0.656 + 0.276 + 0.254 = 1.186$ inches.

A little more difficulty may be experienced in calculating the length of material required for a part such as shown in Fig. 6. This piece is made of soft steel, 3/16 inch thick. The first step is to connect the points X, Y, and Z with lines as shown.

The length of the line $XZ = \dfrac{1.625}{2} + 0.1875 + 0.1875 = 1.187$ inches

Length of line $YZ = 4.75 + 0.1875 + 0.1875 = 5.125$ inches

Sine angle $A = \dfrac{1.187}{5.125} = 0.232$ and angle $A =$ 13 degrees 25 minutes

$$\text{Tan } 1/2 \text{ angle } B = \frac{1/2\ (1.625)}{4.750} = 0.171$$

1/2 angle $B = 10$ degrees approximately
Angle $B = 20$ degrees

$$\text{Sine } 1/2 \text{ angle } C = \frac{1/2\ (0.5)}{4.75} = 0.05263$$

1/2 angle $C = 3$ degrees approximately
Angle $C = 6$ degrees

Now,

Angle $Z = 90$ degrees $-$ 13 degrees 25 minutes $=$ 76 degrees 35 minutes

Angle $F = B + C - A = 12$ degrees 35 minutes

$L_1 = 1.625 - 0.375 = 1.250$ inches

Line $XY = ZY \times \cos A = 5.125 \times 0.972 = 4.982$ inches

$EY = 4.75 + 1.250 + 0.1875 = 6.1875$ inches

$L_2 = EY - (XY + 2 \times 0.1875)$

$L_2 = 6.1875 - (4.982 + 0.375) = 0.830$ inch

Also, $L_3 = L_2$.

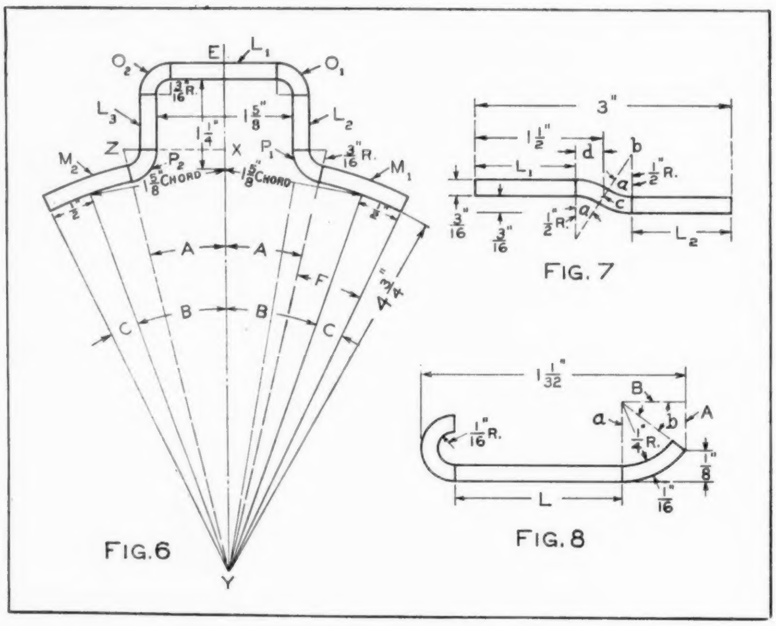
Now, according to the formula in Table 2,

$$M_1 = (0.64T + 1.57R) \times \frac{12.58}{90} = 1.059 \text{ inch}$$

Also, $M_2 = 1.059$ inch

According to Table 2, a 90-degree bend with a radius R of 3/16 inch and a thickness T of 3/16 inch requires a piece 0.414 inch long. Thus the sections O_1 and O_2 each have a developed length of 0.414 inch. As angle $A = 13$ degrees 25 minutes, or 13.42 degrees, the angle subtending the section $P_1 = 90$ deg. $-$ 13.42 deg. $= 76.6$ deg. approximately. Hence, the length of material required for the bend P_1 equals $0.414 \times \dfrac{76.6}{90} = 0.3524$ inch. Also, $P_2 = 0.3524$ inch

Now, adding the lengths of material required for all the straight and bent sections, $M_1 + M_2 + P_1 + P_2 + L_1 + L_2 + L_3 + O_1 + O_2$ of the part shown in Fig. 6, we have: $1.059 + 1.059 + 0.352 + 0.352 + 1.250 + 0.830 + 0.830 + 0.414 + 0.414 = 6.560$ inches. While the lengths determined by the examples considered are given in decimals, the material is sheared to the nearest 1/64 inch.



Figs. 6 to 8. Bent Parts Employed to Illustrate the Applications of Formulas and Tables for Finding Lengths of Material Required

Compound Dies Designed to Overcome Difficulties in Ejecting Work

By WILLIAM C. BETZ, New Britain, Conn.

The use of compound dies of the conventional type has been limited to some extent because of the difficulties experienced in ejecting or removing the work and scrap from the strip stock. The design of compound die shown in the accompanying illustration was worked out to overcome these difficulties. The work *W* can be blanked and pierced in this die and the strip scrap can be carried to the scrap cutter with the same facility as in a combination die, and at the same time, the slug and the completed blank or work can be ejected without requiring any additional operations.

When the punch wall of the lower die and punch member *A* can be made sufficiently heavy to prevent breakage from the wedging action of the piercings, it is possible to make a comparatively inexpensive compound die that will produce accurate blanks by eliminating the knock-out *B* and allowing the slug to drop entirely through the die. If, however, the wall of punch *A* is too light, a spring-operated knock-out, such as shown at *B*, may be used, which will carry the slug back to the die face. The auxiliary knock-out *C* raises the slug sufficiently from this position to permit it to be ejected from the die by an air blast. The blank is forced into the die member *D*, which carries it upward on the up stroke of the ram until it is ejected by the positive knock-out *E*. As the blank drops clear of die *D*, it is ejected by an air blast.

Compound Die with Special Work and Scrap Ejectors for Producing Part Shown at W at Rate of 6000 per Hour

This die is used in an open-back inclined press. The press has a short-stroke positive knock-out in the ram and is equipped with a roll feed and scrap cutter. The work and scrap piercings are safely blown off the back of the press, out of the way of the tools, by the air blast, which is controlled by an air valve operated by a double cam. The press is operated at the rate of 100 revolutions per minute, which gives a production rate of 6000 blanks per hour.

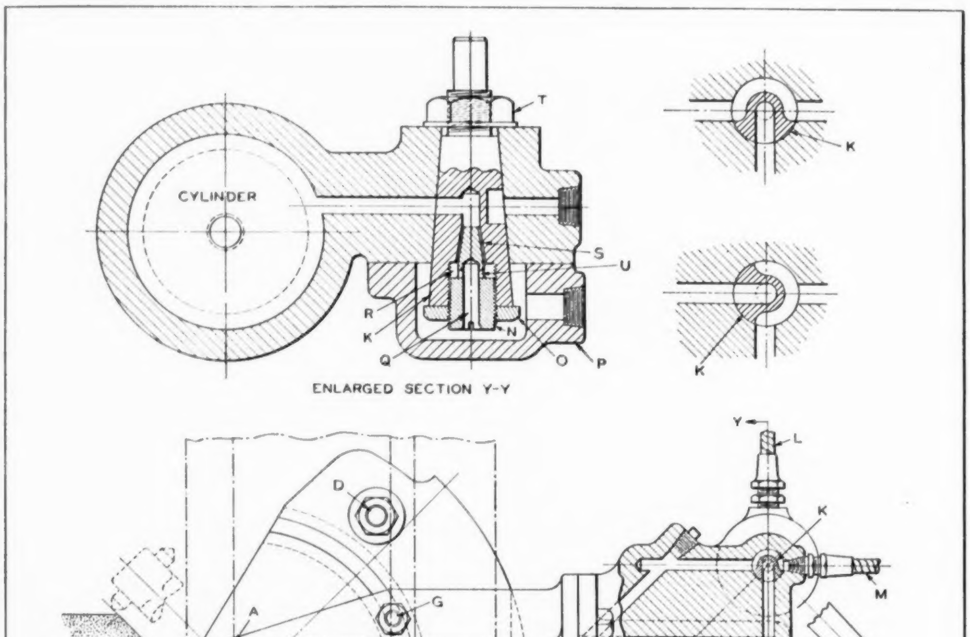
Grinding Wheel Truing Fixture with Hydraulic Traversing Device

By J. R. WHITTLES, Holden, Mass.

Several attempts have been made in the past to design hydraulic truing fixtures for truing angular faces of grinding wheels in a cylindrical grinding machine, but as far as the writer knows, such designs have not been satisfactory mainly because the fixtures have been too large. The hydraulic truing fixture described in the following has been made low in height and very compact, in order to overcome this objection. It has only one cylinder, which is swiveled into position to true one side of the grinding wheel at a time. The only projecting part is the cylinder which overhangs the grinding table.

The fixture can be placed on the grinding table, in back of the footstock, and locked in a fixed position. The table is simply traversed far enough to carry the footstock past the wheel and bring the truing fixture in front of the wheel for the truing operation.

Referring to the illustration, the fixture has two diamonds *A* and *B*, one for truing each of the angular sides of the wheel to an angle of 45 degrees or less. Flexible tubing connected to the hydraulic system of the machine supplies oil under pressure to the cylinder for operating the piston *C* connected to the truing diamond holder, which is thus reciprocated hydraulically for truing the wheel. The truing speed of the diamond is regulated by means of a throttle, shown in the upper view of the illustration. The valve can be set to traverse the piston from 5 to 10 inches per minute. The hydraulic motion obtained by means of the arrangement shown is more uniform than that produced by a hand-feeding device and, as a consequence, the surface of the wheel face will be trued more accurately.



Diagrams Used in Describing the Design and Operation of Hydraulically Actuated Truing Fixture for Grinding Wheel

The truing device is attached to the grinding machine table by means of two hook-bolts *D*, with nuts placed in a pocket to clear the swiveling table, and can be easily removed and placed at the side of the machine when not in use. The micrometer cross-feed and the table traverse of the regular machine are used in positioning the grinding wheel for the truing operation. The cross-feed is then used for feeding the wheel into the diamond for the depth of cut after the fixture has been located as near the center line of the abrasive wheel as possible by means of the table traverse.

The swivel plate, which rests on the top of the fixture body and swivels about the pivot *E* as a center, carries the offset dia-

mond-holder F. The diamond-holder is offset to allow the point of the truing diamond to operate on the center line of the grinding wheel. The swivel plate or base is locked in place by two bolts G which have heads that fit the circular T-slot in the fixture body. Attached to the bottom of the swivel plate is a pointer H which indicates the angular setting. The fixture body is graduated 45 degrees on each side of the center line, so that the swivel plate can be easily set to true the grinding wheel to any desired angle within this range of adjustment.

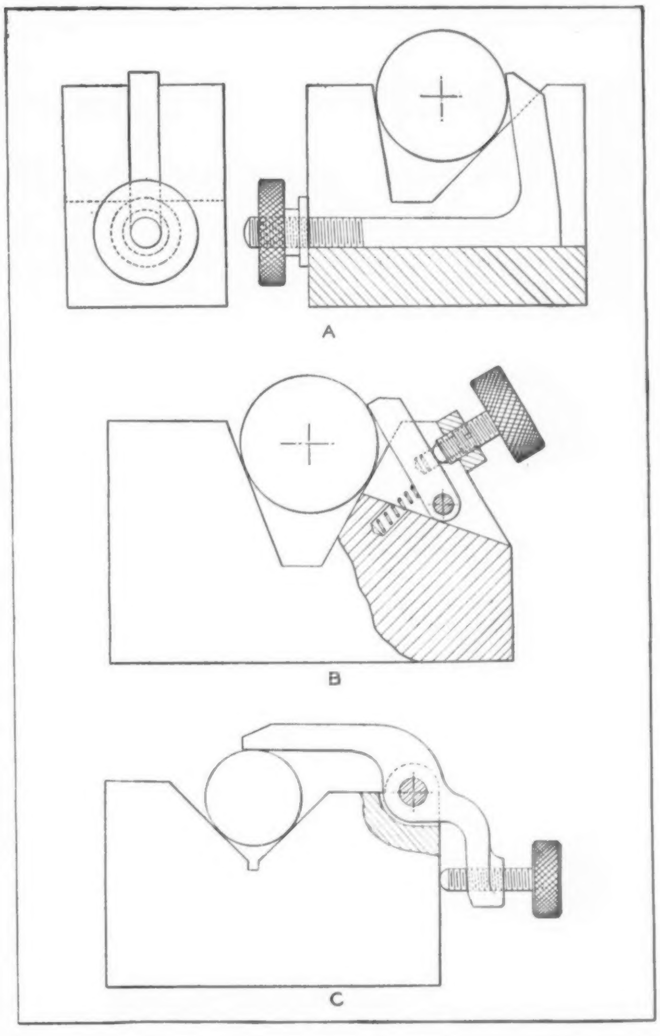
The bearing for the diamond-holder has a slot cut at the top to permit taking up wear by means of two tightening screws, and an opposing screw which prevents adjusting the bearing to too tight a fit on the holder. The slot is filled with a strip of felt to prevent grit and dirt from getting into the bearing.

The diamond-holder is guided in its traversing movements by a feather key I. The holder is turned down at the rear end to form a piston-rod to which the piston C is secured. The swivel plate has a circular flange to which the cylinder is bolted. The arrangement of the oil circulating system of the cylinder is indicated in section X–X. The construction of the operating valve of this hydraulic system is shown by the enlarged section Y–Y in the upper view. The hand-lever J is used to swing the valve K into the proper position for controlling the flow of oil as required to operate piston C.

The pressure and return lines to which the flexible tubing is connected are shown at L and M, respectively. The positions of the valve K for controlling the flow of oil for operating the piston C in both directions are shown in the two upper views to the right. The oil enters through the center of the two-way valve under pressure and returns around the outside of the valve to the oil sump. The needle valve N is locked in position by the nut O. The cap P covers the end of the valve and receives the oil from the pressure line. The drilled holes Q and U allow the oil to enter the needle valve through R. The clearance at S around the tapered portion of the needle valve permits the proper amount of oil to flow through the valve under pressure.

The hand-lever J is shown in position for moving piston C forward. The position of lever J for returning the piston is shown by dotted lines. The oil under pressure enters at L and passes through the hole in the center of the needle valve N at Q, out through the holes at U and through the opening made by the taper of the needle valve at S, thus entering the port that leads to the cylinder. The amount of oil that is permitted to pass by the taper valve at S determines the speed that the piston and diamond will travel when truing the grinding wheel face.

The needle valve N is threaded for adjustment, the slot at the lower end being provided to permit using a screwdriver for making adjustments. The valve body K fits into a tapered hole in the cylinder body and is held in place by means of a lock-nut T, as shown.



Three Types of V-blocks Equipped with Low Clamps for Holding Round Bars

V-Blocks Equipped with Low Clamps to Avoid Interference with Tools

Three V-blocks provided with low clamps that do not project above the tops of the blocks like the conventional types usually employed are shown in the accompanying illustration. The designs shown at A and B leave the top of the work entirely clear for drilling or other operations. The V-block shown at A has a milled slot for the flattened hook-bolt, which is simply dropped into place. This bolt secures an effective hold on round bars in a wide range of diameters. A piece of flat stock can be used at one side of the vee for holding small bars.

The arrangement shown at B consists of a pivoted clamp which accommodates small and large shafts, being forced into contact with the work by a screw in the bar attached to the block by screws at each side of the slot.

The V-block shown at C has the V-notch machined to the angle regularly employed for plain V-blocks, and can, therefore, be used as the latter type when required. The pivot pin of the clamp used with this block is loosely fitted, so that it can be instantly removed when it is desired to use the block in the usual way. F. H.

Perforating and Blanking Dies for Small Ornamental Parts

By M. J. GOLDSTEIN

The strip brass stock, 15/16 inch wide by 0.025 inch thick, used for the ornamental gallery of the candy dish shown in a previous article (page 247, December MACHINERY) is perforated and embossed as shown in the lower view, Fig. 1. The perforating and embossing operations are performed by the three-stage die shown in Fig. 2. The arrangement of the two perforating stages and the embossing stage is shown diagrammatically in Fig. 3.

Although the holes in the perforating die are only 1/16 inch square, they were filed and broached through 5/8-inch tool steel with little difficulty. Very little clearance was given the accurately spaced square holes.

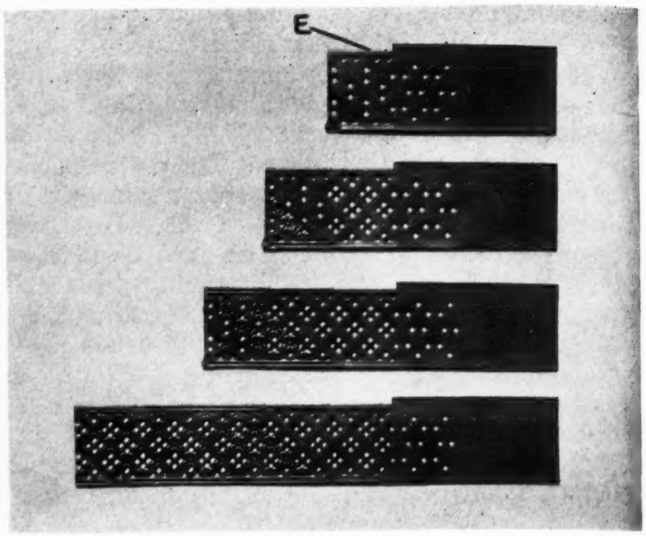


Fig. 1. Strip Stock as it Appears after Four Successive Strokes of a Perforating and Embossing Die

The punches were made 1 1/2 inches long, the material being 1/16-inch square drill rod. The triangular-shaped punches were made by filing away one-half of the square drill rod for a distance of about 3/16 inch from the end. The holes in the punch plate and stripper were made square to receive the shanks of the punches.

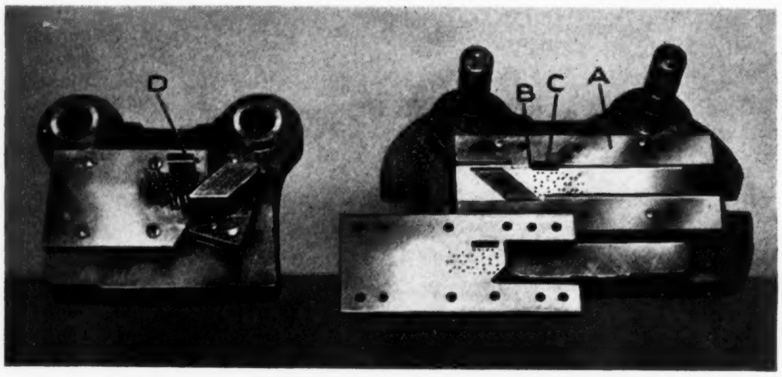


Fig. 2. Punch and Die Members of Perforating and Embossing Die

Accurate feeding of the stock was insured by using a punch type stop consisting primarily of a gage A, Figs. 2 and 3, located at the rear of the die. This gage allows the full width of the metal strip to be fed into the die from right to left until it comes in contact with the point B, which serves as the positive stop. At C is the die opening that receives the punch D, Fig. 2.

At the bottom of the stroke, punch D cuts a narrow strip from the stock, as shown at E in the upper view, Fig. 1. The removal of this stock permits the strip to be fed into the die a distance equal to the length of the die opening, or 0.682 inch, after each stroke of the ram. The three upper views in Fig. 1 show the results of the first, second, and third strokes in perforating and embossing the stock.

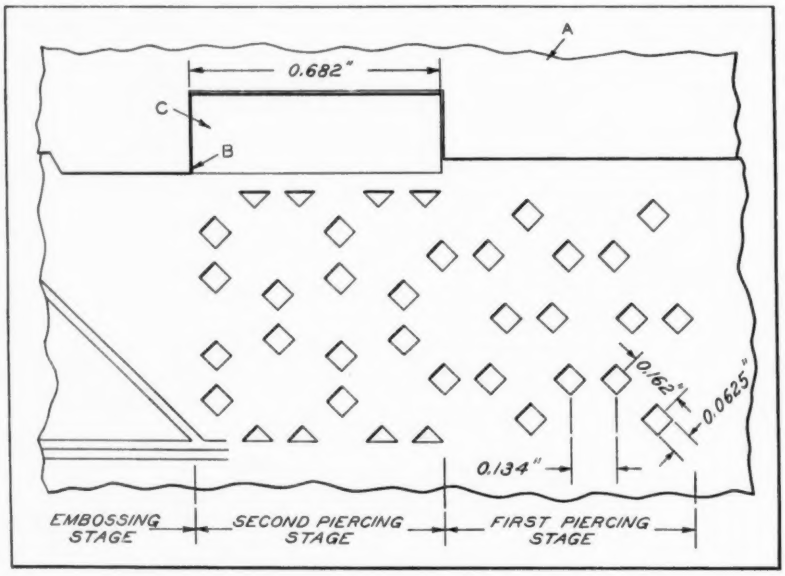


Fig. 3. Diagram Showing Punch-stop Arrangement, as well as Two Piercing Stages and Embossing Stage of Die Shown in Fig. 2

* * *

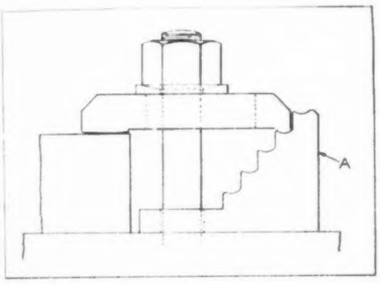
The richest gold fields in the world in South Africa have so far produced a total value of about $7,000,000,000 in gold. During the period from 1900 to 1937, inclusive, the wages paid by the automobile industry have aggregated the stupendous sum of $84,000,000,000—twelve times as much as the value of the gold produced in those fields. This income for labor has been made possible by the automobile; and the automobile, as we know it today, has, in turn, been made possible by the high-production machine.

Ideas for the Shop and Drafting-Room

Time- and Labor-Saving Devices and Methods that Have been Found Useful by Men Engaged in Machine Design and Shop Work

Self-Contained Packing for Hold-Down Clamp

The stepped packing shown at *A* in the accompanying illustration was designed to save time in clamping work on faceplates and machine tables. A foot extending from the base of the packing encircles the bolt, so that the packing is always held in place after loosening the clamping bolt. The concave steps afford a degree of rocking movement for the clamp at different heights and also prevent the clamp from slipping when the hold-down nut is tightened.



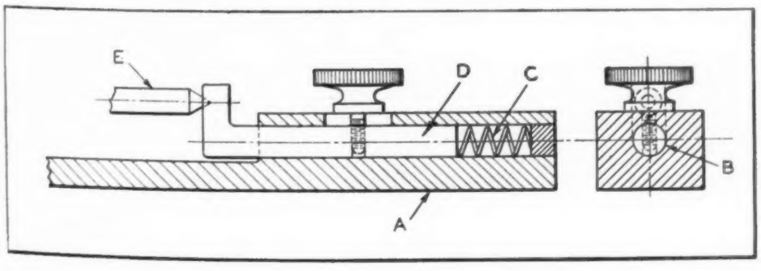
Stepped Packing for Hold-down Clamp

F. H.

Low-Cost Spring-Actuated Holding Appliance

A spring-actuated holding appliance that is somewhat less expensive to make than the one described in September MACHINERY, page 21, is shown in the accompanying illustration. Hole *B*, drilled in base *A*, contains a coil spring *C* and a center holding piece *D* which is machined to a sliding fit in hole *B*. When the knurled-head screw is loosened, the center slide piece can be pulled back by means of the screw, thus compressing spring *C*. Work *E* is held in place when the center slide piece is allowed to slide against the work under the pressure exerted by the spring, after which the slide is securely fastened in place by giving the knurled screw a slight turn.

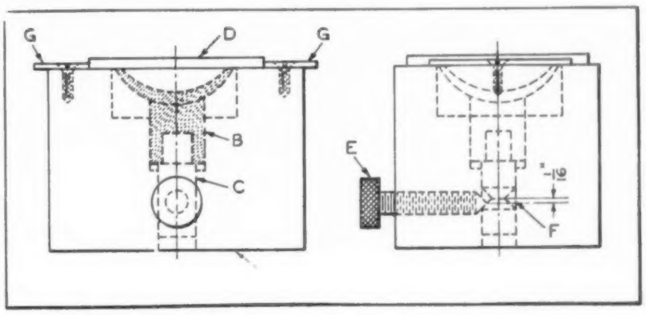
Oakland, Calif. M. JACKER



Spring-actuated Center Support

Holding Work with a Vacuum Cup Solves Surface Grinding Problem

The problem of grinding 0.005 inch of stock from fifty brass plates, 4 inches by 3 inches by 1/8 inch, on a surface grinding machine was solved by making the special holding fixture here illustrated. This fixture can be made any size to suit requirements, and is convenient for holding copper, aluminum, Bakelite, or almost any material having a smooth surface. The suction cup *B* used on the fixture shown is of the conventional type used for lapping or grinding-in automobile engine valves. This vacuum cup is 1 1/4 inches in diameter and will withstand a pull of approximately 9 pounds. Smaller or larger cups are, of course, available.



Fixture with Vacuum Cup for Holding Thin Non-ferrous Work during a Surface Grinding Operation

The body of the fixture consists of a soft steel block *A* which is drilled and counterbored as indicated. Pilot *C* is secured to the vacuum cup *B* with cement. The counterbore for the stem of the cup is a free fit, and the recess for the cup itself is made 1/8 inch larger than the cup to allow for expansion when the cup is pressed on the work.

A cardboard templet is used to centralize the suction cup on the work. The assembly, consisting of the cup *B* and the work *D*, is placed on the block *A*, after which screw *E* is turned so that its conical end advances into the groove in stem *C*, drawing the work *D* down securely on the surface of the block *A*. The work is thus held rigidly in place for the surface grinding operation, the stops *G* being adjusted to come in contact with the work on each end and thus prevent it from being displaced. For grinding flat pieces of irregular shape, the stops *G* can be machined to fit the irregular contours or portions of the contours.

Springfield, Mass. H. J. CHAMBERLAND

Questions and Answers

A Department in which the Readers of MACHINERY are Given an Opportunity to Exchange Information on Questions Pertaining to the Machine Industries

Casehardened Tool Barrels

Q. D.—We make barrels or cylinders for pneumatic tools from S A E 1020 carbon steel, casehardened. Some of these, on high-speed tools, tend to develop longitudinal cracks on the inside, indicating that this part needs improved impact and tensile properties, as the tool delivers over 4000 blows per minute. What alloy steel can you recommend that would eliminate this trouble?

Answered by Editor, "Nickel Steel Topics"

We suggest that you try nickel-molybdenum steel S A E 4615, casehardened, since this steel develops good strength and core toughness, together with a hard, wear-resistant case.

Consideration of the type of failure you encounter leads us to believe that moderately high strength, combined with toughness, is required for this part. On this assumption, we suggest fine-grained steel and the following heat-treatment for the S A E 4615 steel: Carburize at 1700 degrees F. for eight hours (or long enough to achieve the desired case depth). Cool slowly to room temperature, reheat, and quench from 1550 degrees F. in oil.

The resulting properties of the core will then be approximately as follows: Tensile strength, 145,000 pounds per square inch; yield point, 105,000 pounds per square inch; elongation in 2 inches, 17 per cent; and reduction of area, 52 per cent.

When is Machinery a "Fixture" that is Considered Part of a Building?

W. R.—Considerable discussion has arisen from time to time as to whether, when a purchaser breaks a contract to pay for machinery, the seller can remove it from the building if the owner of the building objects to its being removed. What are the conditions under which a seller cannot remove machinery from a building?

Answered by Leo T. Parker, Attorney-at-Law
Cincinnati, Ohio

In order to avoid difficulties of this nature, it is necessary that the seller acquire knowledge of the law relating to "fixtures." Legally, a "fixture" is anything attached to a building in such a manner that its removal will permanently damage the building. Whether equipment connected with or attached to realty becomes a part of it, and therefore is such a "fixture" that it cannot be removed, depends on the circumstances under which the equipment was placed upon the realty and the use to which it is adapted.

For example, in Consolidated v. Smith [189 S.E. 724], it was shown that a machine was installed in a building at the time of its erection, placed on and attached to a foundation under the floor of the building, fitted in an opening in the floor made for it, and attached to the floor. The building was owned by a company that constructed it on leased land.

Later the owner of the building sold it, and litigation developed over the question whether the owner of the machinery had a legal right to remove the machinery. It was contended by the seller that the machinery was not a part of the building, because the title to the building was in one person and the title to the land on which it was located was in another.

In holding that the machine was a "fixture" and that it could not be removed, the Court said: "There is evidence to support the contention of the plaintiff that it [the machine] could be unbolted and removed from the building and its foundation without injury to the building, but it does not necessarily follow from this that such was not a permanent fixture and part of the building."

In other words, if removal of the machine will damage or alter the building, then it is a fixture and cannot be removed by the seller. This is true whether the building is taken over by the holder of a mortgage, or because of a mechanic's lien, whether a new purchaser buys the building, or whether, when the machine was first bought, it was installed by the purchaser in a leased building.

* * *

The Use of Meehanite Castings in Machine Tools

An interesting example of the increasing use of Meehanite castings in machine construction is furnished by the application of castings made from this metal in a newly designed lathe built by the Monarch Machine Tool Co., Sidney, Ohio. In this lathe, all the major castings above the base are made from Meehanite. The bed is a high-strength Meehanite casting, with flame-hardened and ground ways. The headstock, tailstock, carriage, apron, gear-box, and taper attachment castings are also made from Meehanite.

Die Design and Construction

A Treatise on the Principles Embodied in the Design of Different Types of Sheet-Metal Blanking, Forming, and Drawing Dies — Tenth of a Series of Articles

By CHARLES R. CORY*

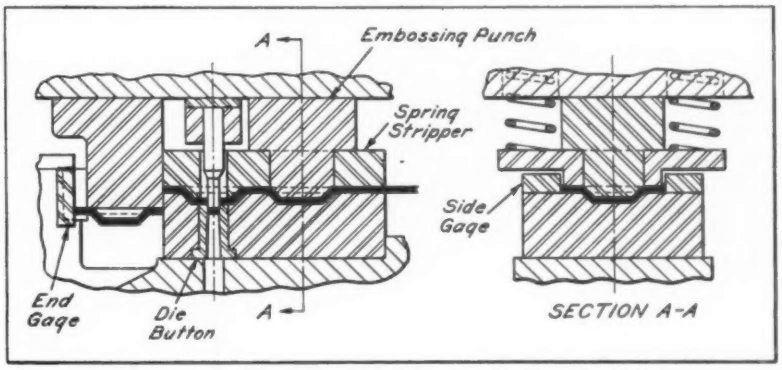


Fig. 7. Spring Stripper Used in a Forming, Piercing, and Cutting-off Die

THE ninth article in this series, published in January MACHINERY, dealt with the shear type piercing and cutting-off die. The present article will continue to illustrate and describe this type of die, beginning by referring to the use of a spring stripper in a cutting-off die.

Some types of cutting-off dies require a spring stripper. This is especially the case when a forming operation is added in a stage preceding the cutting-off stage. Operations such as countersinking, embossing, flanging, and the forming of tabs require a spring stripper to lift the stock strip out of the depressions or holes in the die member prior to feeding the stock strip.

The spring stripper is attached to the punch-shoe by retainer screws, and is forced down by springs, the same as in ordinary blanking dies. The stock channel is omitted, but a side-gage bar is necessary on each side of the stock strip, as indicated in Fig. 7. If it is necessary to spank the stock strip flat to eliminate distortions caused by any of these forming operations, the spring stripper must bottom on the punch-shoe.

*Die Engineer, Fisher Body Division, General Motors Corporation, Detroit, Mich.

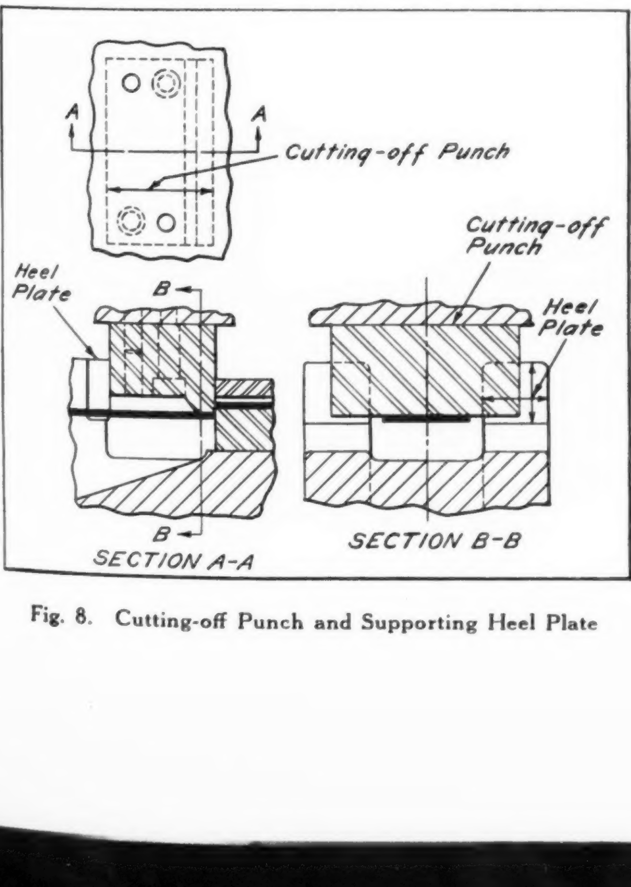


Fig. 8. Cutting-off Punch and Supporting Heel Plate

Design of the Cutting-Off Punch

The hardened cutting-off punch is fastened to the punch-shoe with screws and dowels. The cutting-off operation is completed before the piercing starts, for which purpose the cutting-off punch extends below the level of the piercing punches. The object is to prevent any pull on the stock caused by the cutting-off operation from breaking the piercing punches. The cutting-off punch may be mounted on the punch-shoe at the same level as the piercing punches, or a boss may be provided on the punch-shoe for the cutting-off punch, in order to reduce the height of this punch.

Ordinarily, there is no shear on the cutting-off punch; shear in this instance means the wavy outline of the surface of either the punch or the die generally provided in blanking dies in order that the cutting should not start at the same time throughout the length of the cut. Shear on the cutting-off punch has a slight tendency to cause curling of the blank. Nevertheless, if the stock is thick and the stock strip is wide, it is advisable to add shear to the punch, in order to avoid too heavy a blow on the press. If the blank is turned in a following die, the curling of the blank will be eliminated.

Sometimes the punch is backed up by a heel in the die-shoe, as indicated in Fig. 8. The heel prevents side movement of the punch relative to the die, resulting from the thrust of the cutting-off operation. The heel also prevents the cutting-off punch from tipping. If the heel does not bear directly on the punch member, the latter should have a wide enough base to prevent tipping, and if the

stock being cut is over 1/16 inch thick, the punch should also be backed by a key to take the side thrust off the dowels.

Construction of the Die-Shoe

The cutting-off die, the die-button retainer plate, the stock channel, heel plates, guide pins, and gages are attached to the die-shoe, which also contains the guide-pin bosses. Two guide pins are sufficient, since cutting-off dies are relatively small in area. The guide pins are located at the rear corners of the die-shoe, as indicated in Fig. 9, to provide for the safety of the operator, regardless of the direction of feeding—whether from side to side or from front to rear. The heels are cast on the die-shoe or they may be separate blocks. The heels fit against heels on the punch-shoe or directly against the punch member, as already mentioned. A hardened steel plate may be inserted in the die-shoe heel to decrease wear and permit adjusting with shims.

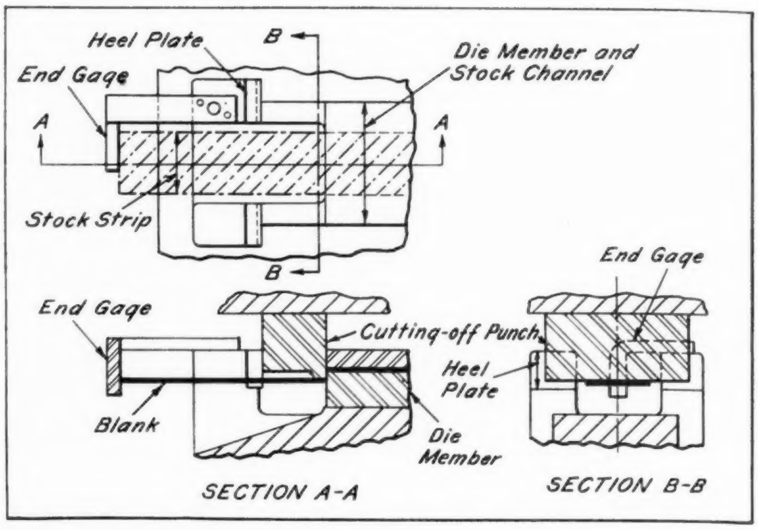


Fig. 10. Arrangement of End Gage for a Cutting-off Die

The slugs pierced from the stock strip are disposed of by one of three methods: (1) They may be shed sidewise down inclined slug chutes in the die-shoe; (2) they may drop through holes in the bolster plate; or (3) they may drop through clearance holes in the die-shoe and into a slug channel, cored or machined in the bottom of the die-shoe. These methods of disposing of the slugs have been described in connection with piercing and blanking dies in previous installments of this series.

The die-shoe must also provide for disposing of the finished blanks. The simplest method is to provide an inclined surface in the direction of the stock feed. An exception to this rule is found in the case of inclined presses, where finished blanks are shed to the rear of the machine.

The direction of feed is from right to left of the press, if it is of the open-side type. If the press is of the column type with closed sides, the direction of feed must, of course, be from front to back. When there is a choice in the direction of feeding, it is advantageous to feed from right to left. With that direction of feed, the finished parts can be removed more easily, as they pile up on the bolster plate. The last blank of the stock strip usually must be supported by the operator to hold it horizontally, since there may be only a very small piece of scrap left to be guided by the stock channel. It is more convenient for the operator to support the last blank if feeding is from right to left.

Construction of the Punch-Shoe

The cutting-off punch and the piercing, notching, or embossing punches are fastened to the punch-shoe. Guide-pin bosses are provided, in which slip-fit holes are reamed for the guide pins. On the whole, there is no difference in the punch-shoes from those used for ordinary blanking and piercing dies. A clamping flange is furnished for fastening the shoe to the press ram. Chain slots are not ordinarily required, since cutting-off dies are seldom heavy enough to require the use of crane chains. If the die-shoe heels do not fit against the cutting-off punch, heels must be cast on the punch-shoe, or separate heel blocks may be fastened to it.

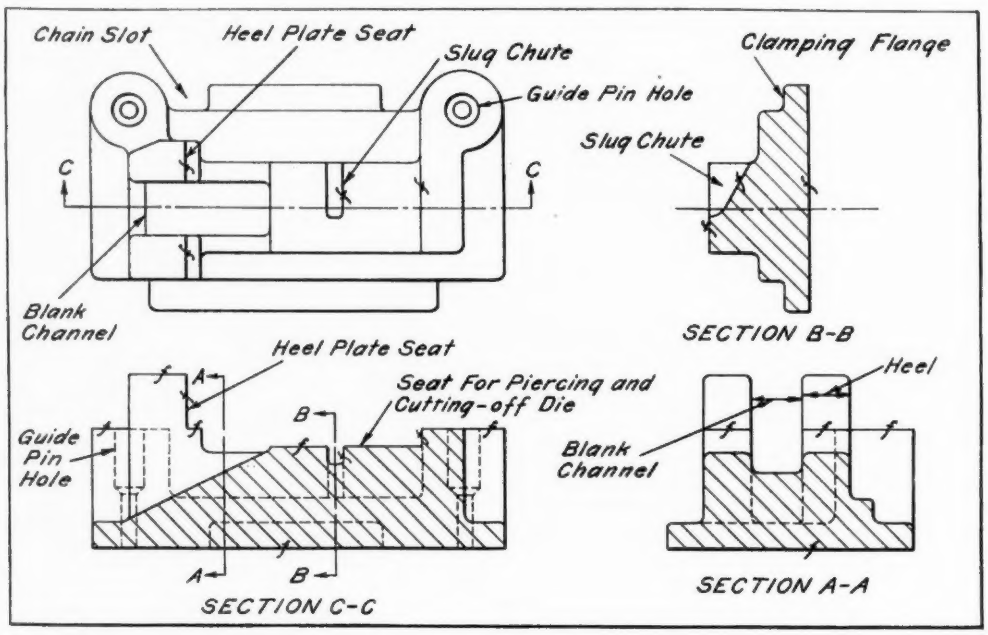


Fig. 9. Design of Die-shoe for a Piercing and Cutting-off Die

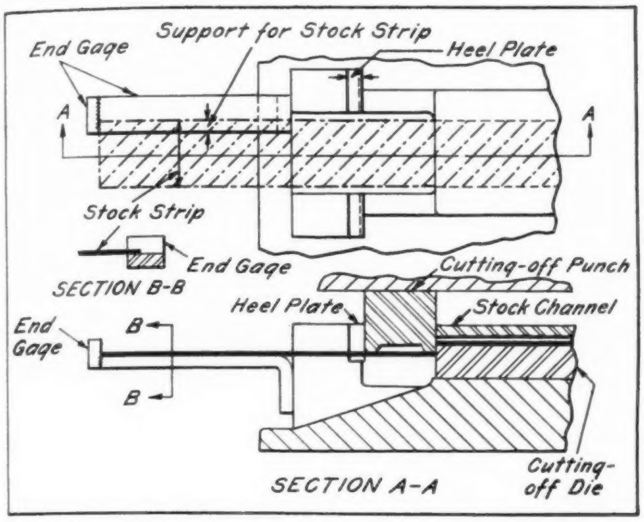


Fig. 11. Gage Support for Long Flexible Stock Strip

As the stock strip is gaged endwise in one direction only, the operator must hold the strip against the gage. The end gage ordinarily clears the stock on the side and only gages it at the end. Consequently, the blank is free to drop after it is sheared from the strip. The end gage is fastened to the die-shoe on the top surface of the heel, as indicated in Fig. 10. The operating end of the gage should extend below the level of the stock strip far enough so that the end of the strip will not sag below the end gage.

With a cutting-off die in which no piercing is done, a new stock strip can be gaged for the first stroke against the end gage, provided the ends of the blank are square with the sides. If they are not square, the stock strip must be fed a short distance beyond the cut-off line for the first die stroke of a new strip to cut off a small piece of scrap, and then for succeeding strokes it is fed against the end gage.

In the case of a cutting-off and piercing die, the method of feeding a short distance past the cutting-off line for the first stroke is also used, regardless of the shape of the end of the blanks. A short piece of scrap is cut off and the holes are pierced in the first stage. Thereafter the stock strip is fed against the end gage.

The finished blank may not fall immediately from the position to which it is pushed by the cutting-off punch. It is held between the end gage and the side wall of the cutting-off die member. On succeeding strokes of the press, the blank is pushed farther down by the new blanks. Eventually the relief on the side wall of the cutting-off die permits the blanks to drop out.

If the blank is long and of thin stock, the stock strip may sag too much between the cutting-off line and the end gage to permit the use of an ordinary type of gage. In that case, the end gage may support about one-fourth of the width of the stock strip to prevent it from sagging (see Fig. 11). Obviously, when the blank is cut off, it will rotate and fall clear of this support. When cutting-off dies have three or more stages, preliminary gages are required. These preliminary gages are designed on the same principles as those mentioned in connection with three-stage blanking and piercing dies.

Gaging Methods where Greater Accuracy is Required

In the ordinary gaging system of cutting-off dies, the operator must push the stock strip against an end gage. The side gaging is inaccurate, since the width of the feeding slot in the stock channel is made over size. Sometimes greater accuracy of blank size is required than could be obtained with this gaging system. For such cases, the ordinary end gage and side gaging in the feeding slot may be used for rough-gaging, but additional finish-gaging devices are necessary.

These finish-gaging devices are similar to those used in connection with blanking and piercing dies of the progressive type. In each of these two types of dies, correct gaging of the stock strip is necessary if the blank is to be correct. In the case of a

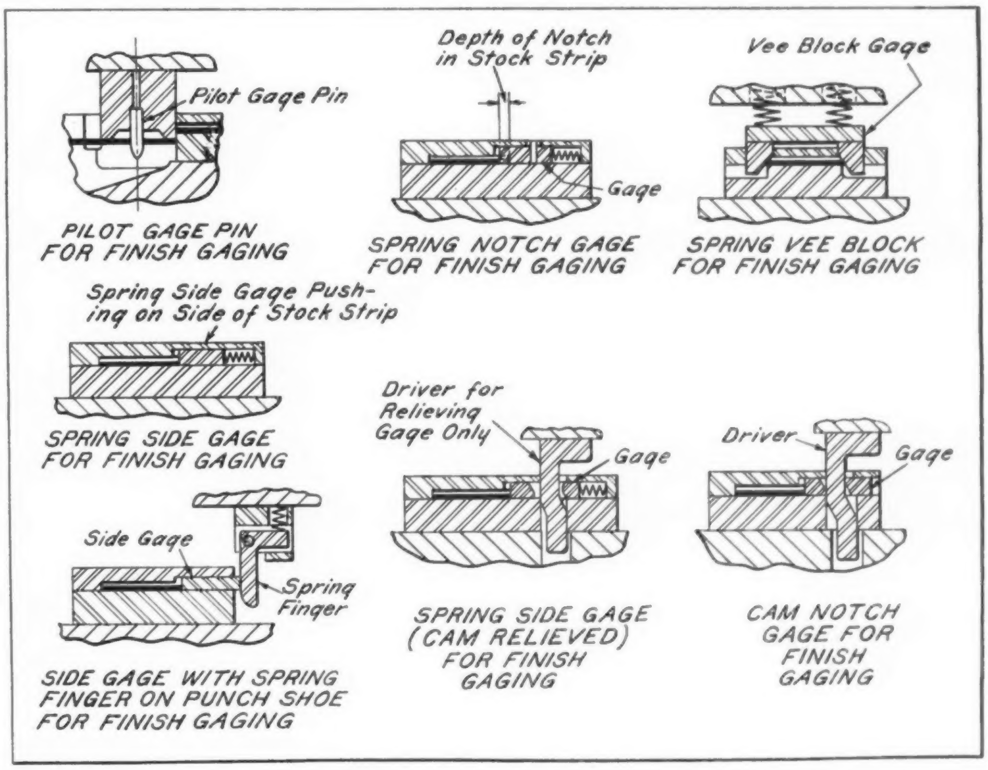


Fig. 12. Arrangements for Finish Gaging

progressive blanking and piercing die, gaging errors will affect the position of the pierced holes in relation to the edges of the blank. If forming operations are also performed in the stage or stages preceding blanking, the location of the formed shape may be incorrect. The size and shape of the blank, however, will not vary, since they are determined by the blanking steel itself.

A cutting-off and piercing die, however, has the possibility of those errors and besides that of an error in the shape of the blank itself. Since the sides of the blank are the sides of the stock strip, any shifting of the strip will change the blank.

Pilot-pins in the cutting-off punch may be used to finish-gage the stock strip in all directions by entering the holes in the stock strip pierced in the preceding stage, as shown in Fig. 12.

A spring notch gage may finish-gage the stock strip in all directions by forcing its way with spring pressure into a notch at the side of the strip pierced in a previous stage. This spring pressure is continuous and acts as a light drag on the feeding of the stock strip.

A cam notch gage may also finish-gage the stock strip in all directions by forcing its way with cam pressure into a notch at the side of the strip. This pressure is relieved in the open die position.

A spring side gage may finish-gage in a sidewise direction only, by pushing against one side of the stock strip with spring pressure. This spring pressure is continuous and makes feeding more difficult.

A spring side gage with a cam relief may finish-gage in a sidewise direction only, by pushing against the side of the stock strip with spring pressure. This pressure on the stock strip is relieved by cam action when the die is open.

A spring V-block may finish-gage in a sidewise direction only, by the equalizing action of two pairs of V-blocks, bearing against each side of the stock strip.

A side gage may be operated by a spring finger on the punch-shoe to finish-gage in a sidewise direction only. In the open-die position, the spring gage is out of contact with the side gage, so that there is no pressure on the stock strip.

Relationship Between Industry and Labor as Seen by a Labor Leader

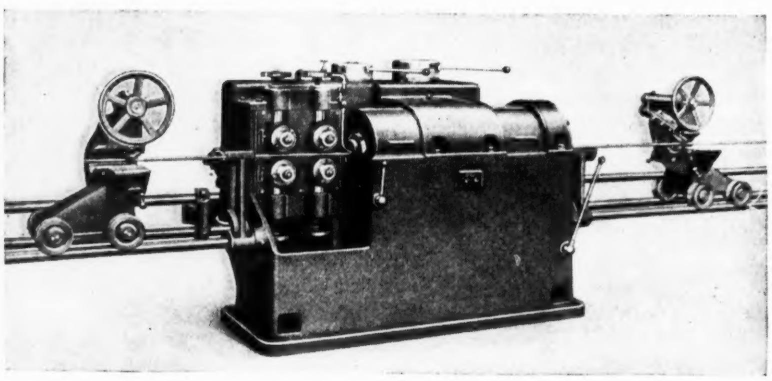
It is of first importance that we create and maintain a friendly and cooperative relationship between industry and labor. This relationship should be brought about not by legal fiat but by a governmental policy that begets the confidence and good will of both. Labor suffers quite as much from governmental control over its relationship to industry as does industry itself. You cannot well regulate the one without at the same time affecting the rights and interest of the other. Failure on the part of Government to adhere to this principle is no less harmful to labor than has been the disregard of this principle by industry when it was in the saddle.

Labor and industry have cause for a common effort in protecting each other against autocratic usurpation of power over their destiny by governmental agency. It makes little difference if such usurpation is exercised by the National Labor Relations Board or any board proposed or designed to fix wages and the conditions under which both industry and labor shall function side by side. Unless both are alert and join in a common cause for defense against such aggressions, we may find later that the time is past in which to retrace our steps. Movements, erroneous or otherwise, once begun generally gain in momentum, and, when headed at full speed, it is almost impossible to put them in reverse without serious consequences.—*Matthew Woll, Vice-president, American Federation of Labor, in the "Greenwich Time."*

* * *

A Centerless Bar-Turning Machine

A centerless bar-turning machine built by Th. Kieserling & Albrecht, of Solingen, Germany, is shown in the accompanying illustration. The bar to be turned passes through the machine in somewhat the same way that a bar passes through a centerless grinding machine. The tool-heads are completely enclosed. These machines will turn shafts to a tolerance of plus and minus 0.001 inch, with a clean, smooth surface. They are made in nine sizes for turning diameters from 1/4 inch to 12 inches. The cutting speeds can be varied from 10 to 130 feet per minute. Machinery steel bars 1 inch in diameter are turned at the rate of 220 linear feet per hour, 4-inch bars at 90 feet per hour, and 8-inch bars at 55 feet per hour; that is, the bars pass through the machine at these rates per hour, completely finish-turned to the tolerance mentioned. The feed is automatic and controlled through a gear-box which permits any desired feed to be obtained. A separate polishing head can also be applied to the machine if required.



A Centerless Bar-turning Machine Built by Th. Kieserling & Albrecht of Solingen, Germany, which Turns Shafts to a Tolerance of Plus and Minus 0.001 Inch

Production of Machine Tool Accessories in the United States

Compiled by the Bureau of the Census

Class	1937	1935	1933
Machine tool accessories and machinists' precision tools, total value....	**$171,222,809**	**$104,938,871**	**$46,878,356**
Attachments and fixtures, total value..........	90,807,860	58,490,850	25,894,336
General equipment:			
Chucks, drill	1,688,279	1,003,433*	
Chucks, lathe	2,554,158	705,247	714,031
Chucks, magnetic	321,778	164,442	
Vises (machine)	233,714	161,308	81,099
Attachments for machine tools:			
Lathe (engine)	727,934	228,625	103,721
Drilling machine	446,782	429,143	
Boring machine	95,479	110,127	804,637
Milling machine	848,228	488,594	
Other machine tool..........	549,744	627,735	98,563
Special equipment:			
Die-casting dies	1,117,890		
Jigs, fixtures, drop-forging dies, sub-presses, punches, dies, etc., and specially designed tools..........	64,421,904	45,633,037	
Semi-finished products (die sets, leader pins, bushings, dowel-pins, die springs, jig bushings, etc.)..........	3,049,279	2,385,658	22,500,685
Tools for screw and automatic machines (box-tools, hollow mills, work- and tool-holders, etc., except taps and dies)..........	3,102,172	1,571,231	
Special machinery (other than machine tools), model and experimental work	4,737,245	1,981,446	
All other attachments and fixtures and balancing machines..........	6,913,274	3,000,824	1,591,600
Small cutting tools and tool-holders, total value..........	66,714,564	39,366,670	17,509,255
Arbors and collars..........	254,452	155,059	
Collets or sockets, etc. (lathe, milling machine, and drill)..........	738,475	343,445	164,477
Counterbores	1,058,200	507,095	56,093
Countersinks and combination countersinks and drills..........	542,891	355,780	104,399
Drills, carbon	2,986,130	1,938,215	
Drills, high-speed	12,202,413	7,043,024	4,508,073
Gear-cutters (other than hobbing)..........	2,317,867	†	†
Hobbing cutters	2,969,934‡	2,131,237	483,784
Lathe, planer, and shaper tools (not including tool-holders):			
Carbon steel	4,860	442,559	†
High-speed steel	970,780		
Tungsten-carbide tipped	508,590	†	†
Milling cutters (all types), end-mills, slotting cutters, etc.:			
Solid			
Carbon steel	526,835	5,262,392	2,446,673
High-speed steel	8,989,344		
Tungsten-carbide tipped	683,843	†	†
Inserted-teeth..........	849,911	1,786,489	1,211,514
Reamers (solid, expansion, and inserted-blade):			
Carbon..........	1,176,305	1,093,671	1,220,359
High-speed..........	3,885,766	2,090,308	
Milling cutters, drills, and reamers not reported separately..........	—	1,112,420	—
Threading tools:			
Taps and dies (not pipe-threading)			
Taps (except collapsible)			
Carbon..........	2,721,898	1,932,483	1,847,588
High..........	5,048,972	1,873,829	
Taps, collapsible	56,303	†	†
Dies, carbon steel..........	1,271,258	862,881	651,534
Dies, high-speed steel..........	397,989	650,002	
Dies, self-opening	285,977	†	†
Chasers..........	2,539,011	1,789,240	1,017,760
Pipe-threading			
Taps (except collapsible)..........	433,580	423,787	405,490
Taps, collapsible	285,722	†	†
Dies..........	848,576	475,403	456,339
Chasers	1,296,240	134,241	†
Pipe stocks complete with dies..........	1,825,142	1,305,541	649,890
All other small cutting tools, tool-holders, mandrels, etc.	9,037,300	5,657,569	2,285,282
Precision measuring tools (micrometer and vernier)	1,581,165	1,182,576	185,868
Gages (plug, ring, snap, thread, etc.)	3,002,642	1,331,676	761,060
Other measuring tools	2,229,363	1,574,575	617,760
Miscellaneous equipment and accessories not included above:			
Wheel-truing (diamond-point and other)	816,355	671,270	†
Other	6,070,860	2,321,254	†
Machine tool accessories, etc., not reported by kind	—	—	1,910,077

*Not strictly comparable; includes the value of chucks and faceplates not reported separately.
†Not called for separately on schedule. ‡Practically all high-speed steel.

Production of Machine Tools in 1937 and 1935

Compiled by the Bureau of the Census

Class	1937 Number	1937 Value	1935 Number	1935 Value
Machine tools (including replacement and repair parts), total	—	**$216,118,544**	—	**$98,982,636**
Bending machines:				
I-Beam, pipe, plate, etc.	272	309,416	629	581,755
Sheet-metal brakes	2,457	1,166,625		
Boring machines:				
Horizontal				
General-utility	29	311,403	604[1]	4,530,214[1]
Boring, drilling, and milling combined	297	3,487,139		
Vertical (not vertical boring mills)	44	306,498		
Special types				
Jig borers	127	772,190		
Precision boring machines	381	1,300,450		
Other types	49	537,067		
Boring mills (vertical—work-revolving):				
General-utility (59" table and under)				
With side-head	447	2,962,759		
Without side-head	21	198,160		
Heavy-duty (above 59" table) with or without side-head	61	1,184,319		
Broaching machines (other than keyseaters):				
Number reported	594	2,236,683	219	668,210
Number not reported	—	—	—	156,886
Cutting-off machines:				
Band-saw				
Number reported	254	187,558	87	61,125
Number not reported	—	110,541	—	—
Hacksaw	2,018	906,357	879	344,754
Other, including cold-saw	223	518,781	44	129,786
Die-casting machines:				
Number reported	66	246,621	(2)	(2)
Number not reported	—	284,084	—	—
Drilling machines:				
Horizontal				
Number reported	452	830,543	140	704,159
Number not reported	—	359,187	—	—
Vertical				
Multiple-spindle (other than sensitive)				
Number reported	731	2,255,415	360	1,143,979
Number not reported	—	—	—	64,833
Standard	581	930,661	—	398,642
Sensitive (including bench type)				
Single-spindle				
Number reported	17,464	1,016,497	8,398	450,295
Number not reported	—	—	—	205,092
Multiple-spindle	779	1,497,584	428	613,466
Horizontal and vertical not reported separately	—	—	—	557,815
Radial (plain and universal)				
Number reported	1,182	4,829,392	250	774,272
Number not reported	—	—	—	324,426
Combined vertical and horizontal (way drills)	86	1,277,892	42	252,966
Drilling and tapping				
Number reported	953	2,033,840	—	—
Number not reported	—	534,507	—	752,036
Other special, including automatic and universal-head				
Number reported	—	—	173	539,392
Number not reported	—	1,521,160	—	423,737
Filing machines	673	118,276	(3)	(3)
Forging machines (hammers, presses, etc.):				
Drop-hammers (impression die)				
Number reported	222	1,740,263	71	494,290
Number not reported	—	—	—	54,125
Forging hammers (flat die)				
Number reported	141	144,764	18	41,147
Number not reported	—	—	—	11,422
Other, including bulldozers and upsetters	—	2,045,748	—	1,517,694
Gear-cutting machines:				
Hobbing machines	692	3,292,954	896	4,612,029
Formed rotary-cutter type				
Number reported	32	181,710		
Number not reported	—	—	—	61,329
Generator and other	1,131	7,384,948		
Grinding machines:				
Cylindrical-external, plain				
Number reported	1,155	8,186,546	618	3,185,921
Number not reported	—	—	—	309,683
Cylindrical-internal	739	4,348,887	503	2,588,024
Cutter and tool (except lathe and planer tool grinders)	1,396	1,862,974	590	738,760
Universal	661	2,110,836	208	646,973

For foot-notes see end of table on page 424.

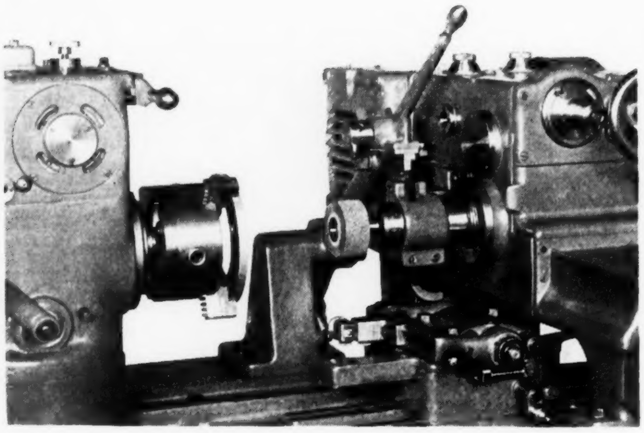
Class	1937 Number	1937 Value	1935 Number	1935 Value
Surface				
Horizontal	2,037	2,896,836		
Vertical				
Number reported	280	1,391,160	1,113	1,933,055
Number not reported	—	53,213		
Tool or snagging (wet or dry, bench or pedestal grinders)				
Number reported	4,525	446,435	1,188	73,556
Number not reported	—	—	—	91,965
Other, including drill, disk, lathe tool, etc.	—	6,832,497	—	3,643,504
Honing and lapping machines:				
Number reported	147	692,299	118[4]	383,129[4]
Number not reported	—	—	—	30,360[4]
Lathes:				
Bench (plain and screw-cutting)	14,663	1,911,181	12,174	1,153,496
Engine, general-utility				
16" swing and under	5,782	7,256,379	1,935	2,249,289
Over 16" swing and including 22"	1,142	3,212,983	504	1,058,129
Over 22" swing and including 36"	278	1,720,962	96	490,311
Heavy-duty, over 36" swing	27	376,851	14	157,869
Gap	32	141.907	18	32,923
Automatic single-spindle				
Bar	1,896	6,313,866		
Center type				
Number reported	101	346,402	823	2,298,028
Number not reported	—	358,542	—	959,174
Chucking	713	3,060,536		
Automatic multiple-spindle				
Bar				
Number reported	1,027	8,916,814	511	2,971,756
Number not reported	—	—	—	632,103
Chucking				
Number reported	371	4,720,165	294	2,548,015
Number not reported	—	—	—	576,818
Turret, horizontal hand-operated				
Ram type	2,168	6,654,278	646	1,523,037
Saddle type (standard and heavy-duty)				
Number reported	970	6,877,897	290	1,699,923
Number not reported	—	—	—	413,789
Other lathes, including polishing and buffing (bench and pedestal) and hand or speed	—	3,246,462	—	791,861
Milling machines:				
Power-feed				
Planer type	208	1,905,595	81	675,325
Universal	1,096	4,376,275	582	1,608,090
Vertical	931	4,141,625	406	1,410,536
Automatic	445	1,186,475		
Plain (including Lincoln type)	1,372	4,513,527		
Other			1,061	3,231,608
Number reported	588	3,119,186	—	30,124
Number not reported	—	—		
Hand-feed	421	343,242		(5)
Planers:				
Standard, over 36"	40	658,686	16	251,439
Open-side	52	567,628	25	172,989
Other, including standard 36" and under	44	330,136	101	128,570
Portable tools:[6]				
Drills				
Electric				
Number reported	79,523	3,921,082	70,730	2,336,920
Number not reported	—	—	—	219,160
Pneumatic				
Number reported	35,035	5,601,252	7,449	1,035,621
Number not reported	—	—	—	1,457,340
Grinders				
Electric	32,918	1,943,192	23,112	1,019,194
Pneumatic			4,534	486,477
Hammers (chipping, riveting, calking, etc.)				
Electric	2,278	283,774	965	115,932
Pneumatic				
Number reported	14,048	919,819	11,830	713,960
Number not reported	—	—	—	156,359
Flexible-shaft machines				
Number reported	3,387	547,565	2,563	289,760
Number not reported	—	—	—	188,100
Other (including portable motor-driven garage equipment) and those not reported by kind				
Number reported	30,278	1,906,851	14,737	790,748
Number not reported	—	2,635,518	—	3,624,882
Presses (except forging):				
Forming	2,433	2,596,129		
Stamping			1,635	3,912,867
Number reported	1,262	4,821,713	—	556,953
Number not reported	—	—		

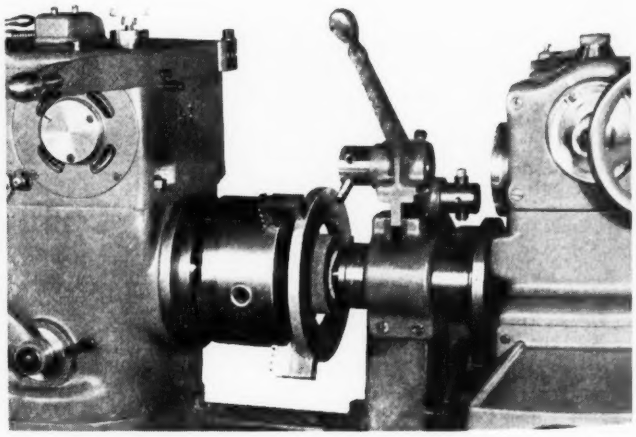
Class	1937		1935	
	Number	Value	Number	Value
Punch				
Number reported	3,694	3,667,023	384	520,697
Number not reported	—	164,135	—	112,776
Other	—	3,797,266	—	1.222,901
Punching machines (not portable)	—	134,673	—	61,701
Riveting machines (not portable):				
Number reported	788	325,464	487	129,812
Number not reported	—	558,033	—	352,986
Shapers:				
Horizontal				
20" stroke and under	513	870,765	248	402,633
Over 20" stroke and including 28"	253	619,003	81	179,987
Over 28" stroke	127	492,270	58	130,918
Vertical } Slotters }	238	665,708	76	208,733
Shears (power):				
Alligator, rotary, and combination punch and shear	465	776,483	355	296,372
Straight	594	1,229,652	482	549,253
Other, including hand-lever and foot-power				
Number reported	1,108	195,686	522	39,398
Number not reported	—	643,988	—	5,708
Threading machines:				
Other than pipe-threading				
Die and rolling type				
Number reported	719	1,124,487	316	426,984
Number not reported	—	113,835	—	—
Milling type	154	851,547	36	188,812
Tapping machines				
Number reported	559	559,946	313	321,996
Number not reported	—	—	—	251,563
Pipe cutting and threading machines				
Single-head	1,759	1,235,454	718	656,525
Multiple-head	—	293,929	—	139,877
All other machine tools	—	3,834,509	—	3,147,851
Replacement and repair parts	—	14,686,518		11.570.873

[1]Not strictly comparable with corresponding figures for 1937 because of differences in the questionnaires for 1937 and 1935. The 1935 figures as published for that year were: Boring machines, horizontal, 321, valued at $1,592,222; vertical, valued at $340,277 (number incomplete); special types (including vertical turret lathes) $2,597,715.
[2]Included with "All other machine tools" to avoid disclosing approximations of data for individual establishments.
[3]Not called for on schedule.
[4]For 1935, reported as "Honing machines."
[5]Does not include data for portable tools made in the "Electrical Machinery, Apparatus, and Supplies" industry for 1937.

Grinding Operations in a German Plant

Photos Courtesy of K. Jung Maschinenfabrik, Berlin, Germany





Figs. 1 and 2. Grinding the Bore and Facing the Side of a Flange in the Same Setting on a Jung Grinding Machine Provided with a Facing Attachment. At the Left is Shown the Attachment in Its Idle Position, while at the Right the Tool is Shown Applied for the Facing Operation

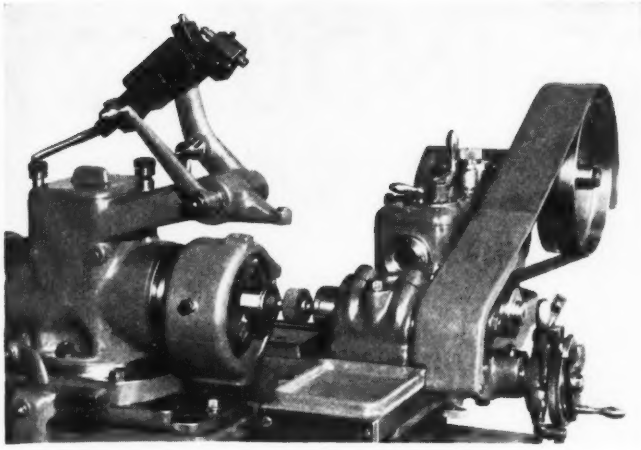


Fig. 3. Internal Grinding of Two Bores Simultaneously by the Use of Two Grinding Wheels which are Mounted on the Same Spindle

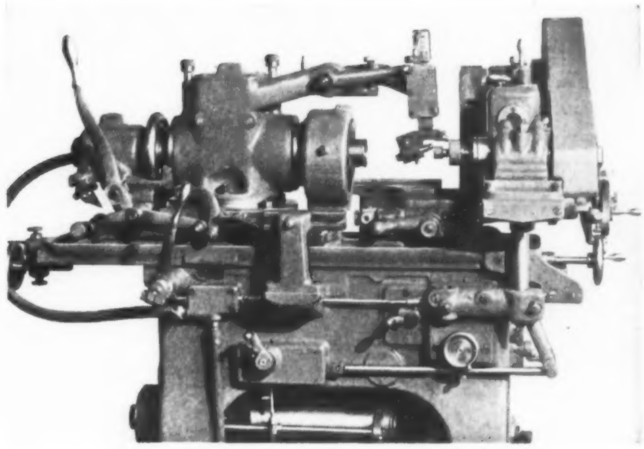


Fig. 4. Attachment for Dressing the Two Grinding Wheels in Fig. 3, Shown in Operating Position. In Fig. 3 the Attachment is Shown Folded Back

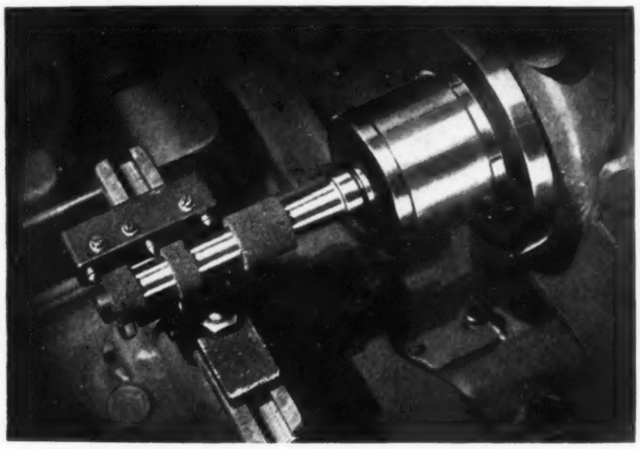


Fig. 5. Grinding Three Bores Simultaneously. Illustration Shows Wheels being Dressed with Three Diamond Dressers

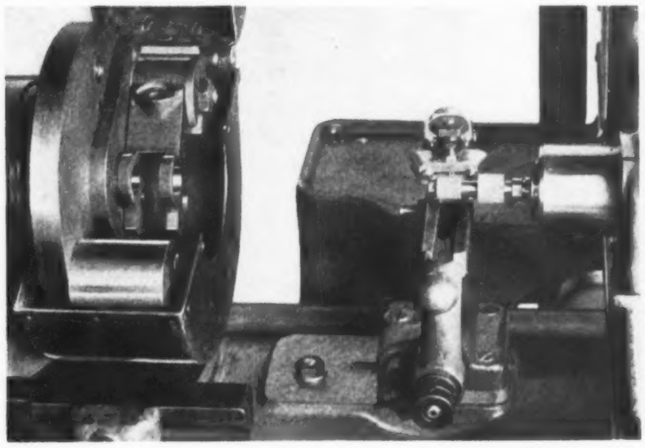


Fig. 6. Another Example of Grinding Two Bores Simultaneously, with Wheel Dressers Shown in Position for Dressing Wheels

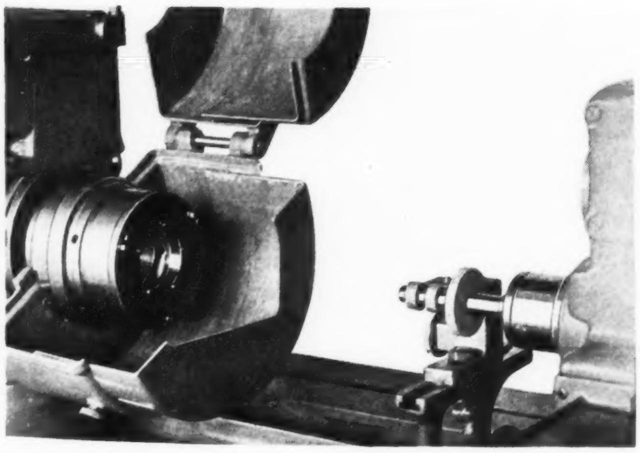


Fig. 7. Another Case where Three Grinding Wheels are Used for Grinding Different Bores Simultaneously

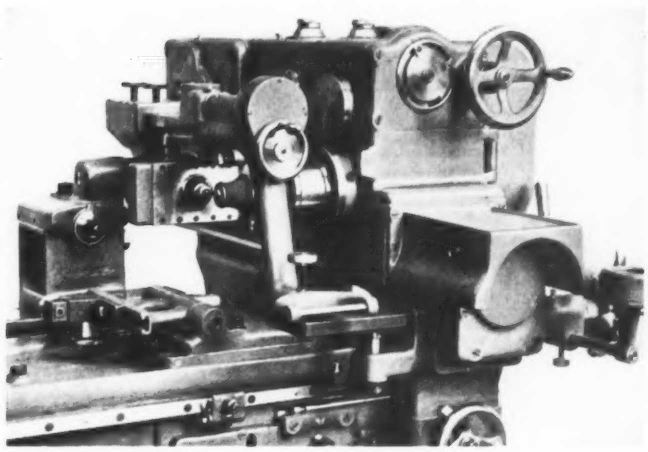
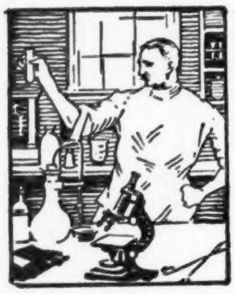


Fig. 8. Machine Arranged for Form Grinding. The Wheel is Dressed by Using a Cam-former as a Guide

MATERIALS OF INDUSTRY

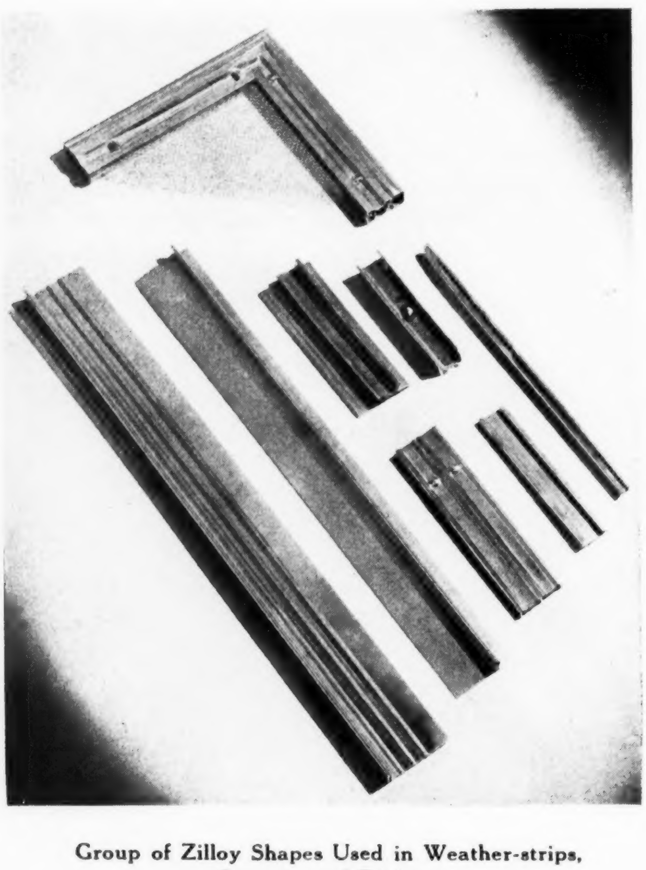


THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

Rolled Zinc Alloys with High Strength and Creep Resistance

The demand for a rolled zinc possessing greater strength than has been available heretofore in the commercial grades has led to the development of a line of Zilloy alloys by the New Jersey Zinc Co., 160 Front St., New York City. These alloys are stiffer, stronger, and have greater creep resistance than the commercial grades of rolled zinc. At the same time, they possess the same corrosion-resistant characteristics and can be fabricated and finished by similar methods.

Zilloy is particularly suitable for fabrication into screen frames, screen guides, splines, weather-strips, corner beadings, and moldings such as illustrated, as well as for the production of stampings that must be of greater strength than is obtainable from commercial grades of rolled zinc.....201



Group of Zilloy Shapes Used in Weather-strips, Screens, and Fittings

Coated Cover Glass for Welding and Cutting Operations

A coated cover glass intended for use with welders' shaded lenses so as to increase the working efficiency of men engaged in welding and cutting operations by preventing blurred vision and eye-strain has been developed by the Mine Safety Appliance Co., Pittsburgh, Pa.

This S.M.A. coated cover glass provides positive protection against molten sparks fusing to the surface, and insulates shaded welding lenses against heat. It outlasts ordinary glass ten to fifty times, thus reducing costs by eliminating the need of frequent replacement.

The glass is available in standard plates and round lenses, and may also be cut to the size required for grinding wheel guards, automatic welding machines, special helmets, and goggles....202

Liquid Compound for Sealing Joints and Seams

A liquid compound intended for use as a permanent seal for joints or seams on equipment handling gases, oil, steam, etc., has been brought out by the Michigan Chrome Co., 6340 E. Jefferson Ave., Detroit, Mich. This compound can be applied to pipe threads, face joints, tank seams, compressors, gaskets, valves, etc., and is said to offer protection against even the smallest opening that might be caused by vibration, expansion, contraction, or chemical damage.

The compound is completely insoluble in gasoline, oil, steam, such gases as Freon, methyl chloride, ammonia and sulphur dioxide, and in the majority of commercial solvents, with the exception of alcohol. It is unusually elastic and will withstand severe vibration without cracking.............203

To obtain additional information about materials described on this page, see lower part of page 430.

Important New Applications for Nickel Alloys in 1938

The past year witnessed continued expansion and diversification of the use of alloys containing nickel. An increasingly greater number of machinery parts and equipment of all types are being fabricated from a variety of alloys in which nickel plays an important part.

Expansion in the use of nickel-bearing stainless steels of the 18 per cent chromium and 8 per cent nickel type was noteworthy in view of the low level of steel operations. Progress was also made in the application of low-alloy, high-tensile, corrosion-resistant steels of the nickel-copper type. Most steels of this type are marketed by steel manufacturers as proprietary products.

Uses have been found for the ferro-nickel alloys. The wide range of properties obtainable by varying the nickel-to-iron ratio has been utilized in a number of applications. Another special high-nickel alloy—a combination of nickel, cobalt, aluminum, and iron—has been applied very successfully to the manufacture of permanent magnets.

Pronounced advances were made in the field of clad metals. Inconel-clad steel, recently introduced as a companion to nickel-clad steel, has become of some importance in industry. It is useful where a relatively low-cost construction is desired, with corrosion resistance and other properties of Inconel.

By recent developments in the so-called bright nickel-plating process, it is now possible to plate strip steel continuously and fabricate pressed and drawn articles directly from the plated sheets. The development of Z-Nickel, a non-ferrous metal, was one of the important forward steps in 1938. It contains 98 per cent pure nickel and can be heat-treated. This metal has been produced in certain forms with a tensile strength of 250,000 pounds per square inch and hardness values up to 46 Rockwell C. The corrosion-resistant properties are retained.

Practically all the large planes built or projected in recent months are equipped with parts made from Inconel. This high-nickel-chromium alloy is useful for exhaust manifolds and cabin heaters. Another noteworthy development is the use of approximately 60,000 pounds of rolled nickel for lining the cargo tanks of an ocean-going freighter for transporting caustic soda.

Since alloys containing nickel are used primarily where the conventional metals are inadequate, and where strength, toughness, and greater resistance to heat, corrosion, wear, and abrasion are desired, the progress in 1938 reflects the development of trends previously established rather than a series of spectacular innovations..................204

New Type Colloidal Graphite Used for High-Temperature Lubrication

Conveyor chains operating in high temperatures, as, for example, in baking and enameling ovens, are being effectively lubricated by a new form of colloidal graphite, so finely divided that it can be suspended in a volatile liquid. The liquid, which in this case is kerosene, merely evaporates, leaving a very thin deposit of colloidal graphite on the surfaces to be lubricated. Experience has shown that this film of graphite, although extremely thin, will provide lasting lubrication for surfaces under high operating temperatures.........................205

Four Castings Similar to the One Shown were Recently Produced by the Spuck Iron & Foundry Co., St. Louis, Mo., for Use as Entrance Nozzles in Reservoir Discharge Castings, an Application that Required Strength and High Corrosion Resistance, as the Drain Water Handled Contained Sulphuric Acid. The Necessary Properties were Obtained with Economy by Producing the Castings from the Copper-Molybdenum Cast Iron "Sifcoloy," which Contains 3.10 Per Cent Carbon, 1.14 Per Cent Silicon, 0.67 Per Cent Manganese, 0.08 Per Cent Sulphur, 0.62 Per Cent Copper, and 0.76 Per Cent Molybdenum. The Tensile Strength is Approximately 58,000 Pounds per Square Inch and the Hardness 250 Brinell

To obtain additional information about materials described on this page, see lower part of page 430.

NEW TRADE  LITERATURE

Electric Equipment and Accessories

GENERAL ELECTRIC Co., Schenectady, N. Y. Bulletins GEA-594B, 2872, and 2964, dealing, respectively, with automatic control panels for industrial electric heating; metal-enclosed switchgears; and full-voltage magnetic motor starters. Booklet 2989, entitled "How to Make Cable Joints — Portable Cable," containing instructions for splicing and vulcanizing rubber-insulated, rubber-jacketed, portable cable. 1

Milling Machines and Attachments

CINCINNATI MILLING MACHINE Co., Cincinnati, Ohio. Booklet entitled "Physics of Metal Cutting," containing the reprint of a lecture presented by Hans Ernst at the last annual convention of the American Society for Metals. Bulletin M-803, descriptive of the Cincinnati high-speed universal milling attachment for application to the newer Cincinnati millers. 2

Automatic Machines

CONE AUTOMATIC MACHINE Co., Windsor, Vt. Two new Operators' Handbooks, containing information on the construction and operation of four-spindle and eight-spindle Conomatics, including instructions for setting up; care and adjustment; selection of cams, speeds, and feeds, etc. 3

Combination Turning Tools

R & L TOOLS, 1825 Bristol St., Nicetown, Philadelphia, Pa. Catalogue showing different applications of the R & L combination right- and left-hand turning tool by means of which several operations, such as turning, drilling, centering, chamfering, etc., can be performed at one time. 4

Indicating and Controlling Instruments

BROWN INSTRUMENT Co., Wayne and Roberts Aves., Philadelphia, Pa. Folder G-37, illustrating this company's complete line of indicating, recording, and controlling instruments for measuring and controlling temperatures, pressures, flows, liquid levels, and humidity. 5

Recent Publications on Machine Shop Equipment, Unit Parts and Materials. To Obtain Copies, Check on Form at Bottom of Page 429 the Identifying Number at End of Descriptive Paragraph, or Write Directly to Manufacturer, Mentioning Catalogue Described in the February Number of MACHINERY

Hydraulic Grinding Machines

LANDIS TOOL Co., Waynesboro, Pa., Catalogue J-538, descriptive of the Landis 14-inch Type C hydraulic universal grinding machine. Catalogue D-38, covering 6-inch Type C plain hydraulic grinders. Many typical operations on these machines, showing their application on a variety of work, are illustrated. 6

Precision Boring and Facing Machines

EX-CELL-O CORPORATION, 1212 Oakman Blvd., Detroit, Mich. Bulletin 11181, illustrating and describing Ex-Cell-O precision facing machines. Bulletin 11481, descriptive of Ex-Cell-O three-way and two-way precision boring machines. 7

Ground-Thread Taps and Dies

DETROIT TAP & TOOL Co., 8432 Butler, Detroit, Mich. Circular entitled "When, Why, and How to Grind Threads," outlining the advantages of ground-thread taps and dies, and showing examples of work for which these tools are especially adapted. 8

Sheet-Metal Forming Machine

ENGINEERING & RESEARCH CORPORATION, Riverdale, Md. Circular describing the "Erco" improved sheet-metal former, which performs difficult flanging and forming operations previously limited to hand production. 9

Engine-Drive Design Data

LINK-BELT Co., 519 N. Holmes Ave., Indianapolis, Ind. Engineering Data Book No. 1645, on Silverstreak silent chain and Silverlink roller chain drives for automotive and stationary engines (timing and accessory driving). 10

Universal Tool Milling Machines

H. P. PREIS ENGRAVING MACHINE Co., 157 Summit St., Newark, N. J. Catalogue descriptive of the Deckel FP 1 universal tool milling machine, showing many examples of work, indicative of the wide range of application of this machine. 11

Presses and Shears

LONG & ALLSTATTER DIVISION OF COLUMBIA MACHINE TOOL Co., Hamilton, Ohio. Circular illustrating typical examples of the line of metal-working machines made by this company, including punches, presses, shears, and press brakes. 12

Brazing Alloy

HANDY & HARMAN, 82 Fulton St., New York City. Bulletin 11, describing the right procedure for brazing cemented-carbide tool tips to tool-holders with "Easy-Flo" No. 3 brazing alloy, a low-temperature brazing alloy with a medium silver content. 13

Flexible Couplings

CHARLES BOND Co., 617-623 Arch St., Philadelphia, Pa. Folder entitled "Important Changes in the Bondtru Flexible Insulated Coupling," showing how these improvements are providing for greater horsepower capacity and larger maximum bores. 14

Laying-Out and Inspection Equipment

PUMP ENGINEERING SERVICE CORPORATION, 12910 Taft Ave., Cleveland, Ohio. Circular illustrating and describing the "Index Master," a simple, accurate device for laying out and checking angular work. 15

Band Filing Machines

CONTINENTAL MACHINE SPECIALTIES, INC., 1301 South Washington

Ave., Minneapolis, Minn. Folder descriptive of a new band filer for internal and external filing on materials ranging from high-carbon steel to soft brass, wood, etc. 16

Electric Hoists and Cranes

ROBBINS & MYERS, INC., Springfield, Ohio. Bulletins 7171, 7272, 7373, 7474, and 7575, treating, respectively, of small electric hoists; electric worm hoists; large electric hoists and trolleys; cranes; and winches. 17

Industrial Washing Equipment

INTERNATIONAL CONVEYOR AND WASHER CORPORATION, Detroit, Mich. Circular descriptive of the Hydro-Flow new washing machine for industrial plants. Circular entitled "How Do You Wash Your Metal Parts?" 18

Industrial Vacuum Cleaners and Blowers

CLEMENTS MFG. CO., 6650 S. Narragansett Ave., Chicago, Ill. Circular containing information on the Clements Cadillac two-speed blower for industrial cleaning and spraying. 19

Bonded Metals

AMERICAN NICKELOID CO., Peru, Ill. Circular showing typical applications of American bonded or pre-finished metals in electrical devices, vending machines, automotive accessories, and similar parts. 20

Welding Equipment

LINCOLN ELECTRIC CO., Cleveland, Ohio. Application Sheet No. 63 in a series on machine design, treating of the economics of welded design and practical applications, including savings effected. 21

Sheet-Metal Working Machines

NIAGARA MACHINE & TOOL WORKS, 637 Northland Ave., Buffalo, N. Y. Bulletin 103-C, containing data on school equipment and typical floor lay-outs for different sizes of sheet-metal classes. 22

Electric Motors

ALLIS-CHALMERS MFG. CO., Milwaukee, Wis. Bulletin 1195, entitled "Save on Service Costs with Allis Chalmers 'Lo-Maintenance' Motors," descriptive of squirrel-cage induction motors. 23

Flexible Metal Hose

CHICAGO METAL HOSE CORPORATION, Maywood, Ill. Catalogue G-14, containing illustrations and engineering data on Rex-Weld corrugated metal hose, Rex-Tube asbestos-packed hose, and other types. 24

Air-Line Lubricators

C. A. NORGREN CO., INC., Denver, Colo. Circular descriptive of the Norgren combined strainer and sight-feed automatic air-line lubricator for conditioning air for the operation of air-operated tools. 25

Hydraulic Cylinders

HANNIFIN MFG. CO., 621-631 S. Kolmar Ave., Chicago, Ill. Bulletin 35-A, descriptive of an improved type of high-pressure hydraulic cylinder for all classes of hydraulic power applications. 26

Alloy-Steel Chain

JOSEPH T. RYERSON & SON, INC., 16th and Rockwell Sts., Chicago, Ill. Bulletin explaining the advantages of Taylor heat-treated alloy-steel sling chain, carried in stock for immediate shipment. 27

Sensitive Drills

CRESCENT MFG. CO., 1104 Tenth St., Rockford, Ill. Circular illustrating and describing the Redin No. 0 sensitive drill for both high-speed production work and accurate tool-room jobs. 28

Hoisting and Conveying Equipment

INTERNATIONAL CONVEYOR AND WASHER CORPORATION, Detroit, Mich. Circular outlining the mechanical features of the new International electric hoist. 29

Plastic Materials

PLASKON CO., INC., 2112 Sylvan Ave., Toledo, Ohio. Booklet entitled "Molded Color," containing information on the properties and many applications of the molding material "Plaskon." 30

To Obtain Copies of New Trade Literature

listed on pages 428-430 (without charge or obligation) mark with X in the squares below, the publications wanted, using the identifying number at the end of each descriptive paragraph; detach and mail to:

MACHINERY, 148 Lafayette St., New York, N. Y.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48

Name .... *Position or Title* ....

[This service is for those in charge of shop or engineering work.]

Firm ....

Business Address ....

City .... *State* ....

[SEE OTHER SIDE]

Meehanite Metal

MEEHANITE RESEARCH INSTITUTE, Vandergrift Bldg., Pittsburgh, Pa. Booklet 100, describing the use of Meehanite in castings for pumps that must meet severe service requirements. 31

Welding Hose

HEWITT RUBBER CORPORATION, Buffalo, N. Y. Circular on the Twinweld welding hose, which consists of two lines of welding hose molded into a single unit. 32

Hoist and Crane Motors

WESTINGHOUSE ELECTRIC & MFG. Co., East Pittsburgh, Pa. Leaflet 3530, descriptive of hoist and crane motors for exacting electrical and mechanical requirements. 33

Rustproofing Processes

PARKER RUST-PROOF Co., Detroit, Mich. Catalogue describing the advantages and applications of the Parkerizing rustproofing process for protecting iron and steel. 34

Precision Measuring Instruments

FEDERAL PRODUCTS CORPORATION, 1144 Eddy St., Providence, R. I. Catalogue 38, showing improvements and additions to the Federal line of precision measuring instruments. 35

Material-Handling Equipment

AMERICAN MONORAIL Co., 13107 Athens Ave., Cleveland, Ohio. Catalogue entitled "How Handling Problems have been Solved with American Monorail." 36

Chaser Grinders

LANDIS MACHINE Co., INC., Waynesboro, Pa. Bulletin A-87-1, covering chaser grinders for grinding Landis tangential chasers, and chaser grinding fixtures. 37

Precision Grinders

DUMORE Co., Racine, Wis. Catalogue illustrating and describing Dumore precision grinders and typical applications on tool-room and production work. 38

Tension Indicators

AUTOMOTIVE MAINTENANCE MACHINERY Co., North Chicago, Ill. Circular descriptive of Ammco tension indicators for tightening bolts uniformly to a predetermined stress. 39

Hoisting Equipment

YALE & TOWNE MFG. Co., Philadelphia, Pa. Circular descriptive of the "Cable King" wire-rope electric hoist with capacities from 1/4 ton to 6 tons. 40

Electric Hand Saws

PORTER-CABLE MACHINE Co., Syracuse, N. Y. Circular illustrating and describing the new Porter-Cable 10-inch "Speedmatic" electric hand saw. 41

Mechanical Screwdriver Feeder

AKRON AUTOMATIC MACHINE Co., 100 Beech St., Akron, Ohio. Circular describing a mechanical feeder for portable power screwdrivers. 42

Centerless Grinding Machines

CINCINNATI GRINDERS, INC., Cincinnati, Ohio. Catalogue G-424, on the new Cincinnati No. 2 centerless grinding machine. 43

Heat-Treating Equipment

AMERICAN GAS FURNACE Co., Elizabeth, N. J. Bulletin 801, describing automatic rotary heating machines for continuous heat-treating. 44

Industrial Dust Collector

FALSTROM Co., Passaic, N. J. Circular illustrating and describing "Dustrol," an inexpensive, portable dust-collecting unit. 45

Speed Reducers

JANETTE MFG. Co., 556-558 W. Monroe St., Chicago, Ill. Bulletin 22-7, on Janette motorized speed reducers. 46

Variable-Speed Transmissions

IDEAL COMMUTATOR DRESSER Co., Sycamore, Ill. Leaflet describing Select-O-Speed transmissions. 47

Metal Spray Gun

TURNER BRASS WORKS, Sycamore, Ill. Publication describing a spray gun suitable for lead-tin alloys. 48

To Obtain Additional Information on Shop Equipment

Which of the new or improved equipment described on pages 431-445 is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equipment mark with X in the squares below, the identifying number found at the end of each description on pages 431-445—or write directly to the manufacturer, mentioning machine as described in February MACHINERY.

51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	

Fill in your name and address on other side of this blank.

To Obtain Additional Information on Materials of Industry

To obtain additional information about any of the materials described on pages 426-427 mark with X in the squares below, the identifying number found at end of each description on pages 426-427—or write directly to the manufacturer, mentioning name of material as described in February MACHINERY.

201	202	203	204	205

Fill in your name and address on other side of this blank.

Detach and mail to MACHINERY, 148 Lafayette St., New York, N. Y.

[SEE OTHER SIDE]

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

Hardinge High-Speed Precision Tool-Room Lathe

A precision high-speed tool-room lathe embodying improvements in design that are the result of fifty years' experience in the manufacture of high-speed tool-room machinery is being placed on the market by Hardinge Bros., Inc., Elmira, N. Y. This lathe has been designed to handle efficiently, tool-room work that is too large or too complicated to be machined on a bench lathe and too small to be finished economically or satisfactorily on an engine lathe. In effect, it combines the accuracy, speed, and convenience of a precision bench lathe with the thread cutting facilities, power, and ruggedness of an engine lathe, thus filling the gap between these two types of lathes.

As shown in the accompanying illustrations, the machine has a pedestal cabinet, in which there is space for storing chucks, tools, collets and other attachments. The pedestal fully encloses the motor, controls, and driving unit. A standard two-speed ball-bearing motor is connected by an endless V-belt to a four-step aluminum pulley, giving eight forward and eight reverse spindle speeds ranging from 165 to 1750 R.P.M.; with the 6 1/4-to-1 ratio back-gears engaged, the speed range is from 27 to 280 R.P.M.

The hardened and ground spindle takes a 1-inch capacity collet and is mounted in duplex preloaded super-precision type ball bearings that permit no axial play. The "thirty" change-gear box provides quick change for all standard threads in all thread systems above and including eleven threads per inch; this includes 11 1/2 and 27 standard pipe threads. A wide range of special threads can be cut by employing compound gearing outside the quick-change gear-box.

There is a handwheel for turning the spindle by hand. This wheel is graduated for accurate indexing when cutting double, triple, or quadruple threads. Movement of a single lever leaves the spindle "free" on its ball barings, so that it can be rotated by hand for balancing work held on a faceplate.

There is a quick-acting device that withdraws the tool for cutting threads. The top-slide and cross-feed screws have precision square threads and dials graduated to 0.001 inch. The 360-degree graduations on the

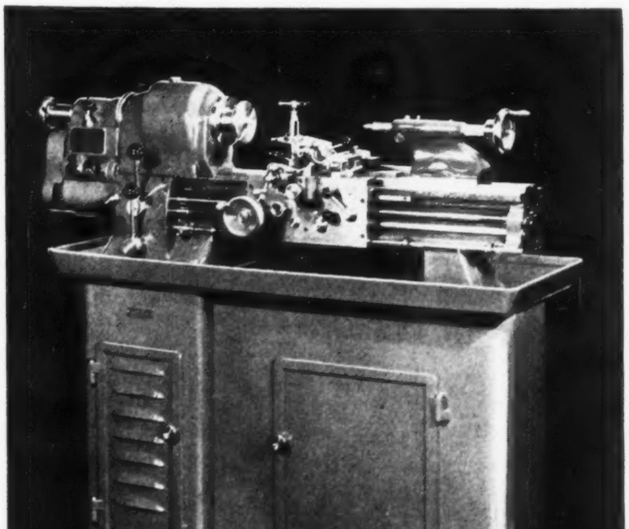


Fig. 1. Hardinge High-speed Precision Tool-room Lathe with Quick-change Gears for Thread Cutting

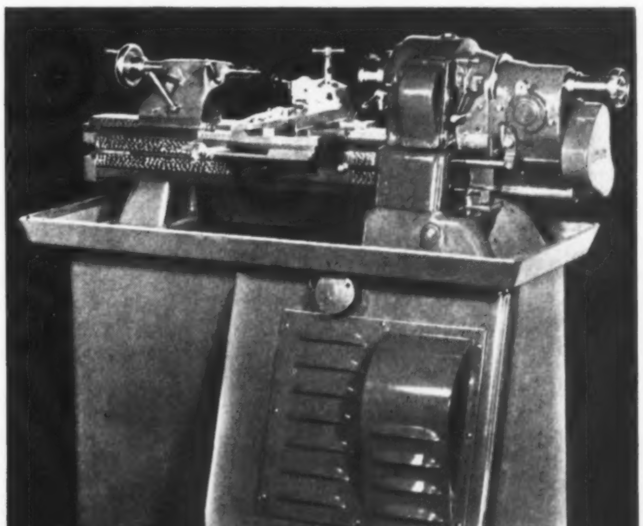


Fig. 2. Rear View of Hardinge Lathe, Fig. 1, Showing Taper Turning Arrangement and Back-gear Housing

To obtain additional information on equipment described on this page, see lower part of page 430.

top of the cross-slide are read through an opening in the swivel base. The top slide has a travel of 4 inches. The toolpost takes a 3/8-inch square tool bit or standard tool-holder. The cross-slide has a travel of 4 3/4 inches and is provided with adjustable stops. The hand-feed has a friction dial graduated in sixty-fourths of an inch. An interlock prevents the power feed and the lead-screw from being engaged at the same time. The control levers for starting, stopping, reversing, and changing speeds are so located as to permit rapid and easy operation.

The extremely accurate work and fine finish obtainable with this lathe are due in a large measure to the dovetail construction of the carriage and bed, which have been designed to eliminate chatter. The self-adjusting steel balls of the three-point bearing between the lathe bed and the base prevent any possibility of the bed being distorted by irregularities in the surface of the floor. The lathe illustrated has a 1-inch collet capacity, 16 inches between centers, and a 9-inch swing. The complete machine, with motor ready to run, weighs 1020 pounds. 51

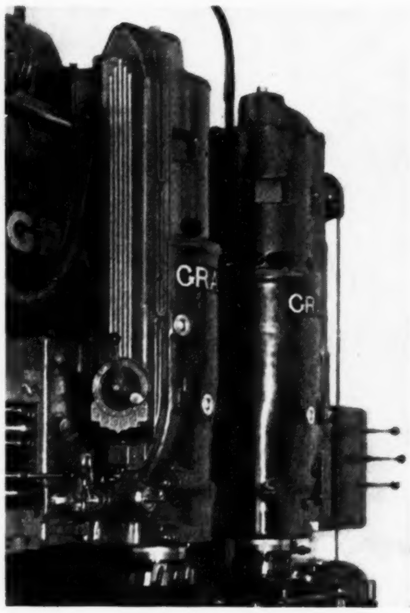


Fig. 2. Close-up View of Unit Type Milling Heads on Cross-rail

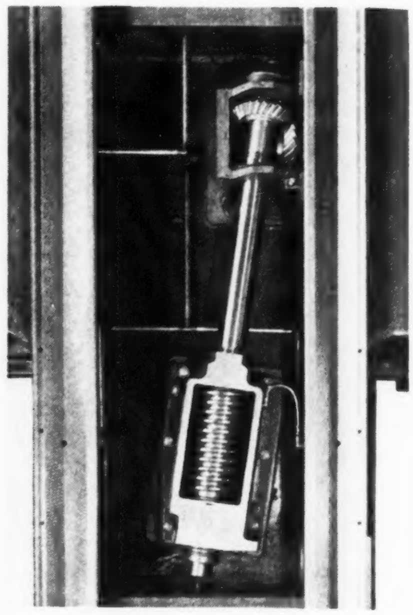


Fig. 3. Hypoid and Spiral Gear Drive to Table of Gray Milling Machine

Gray Unit-Head Type Milling Machine

A milling machine that is a radical departure in design from conventional types has been brought out by the G. A. Gray Co., 3611 Woodburn Ave., Cincinnati, Ohio. This new machine is of the unit-head type, designed to combine the speed, flexibility, and ease of control characteristic of small knee type machines with the power, rigidity, and accuracy of planer type machines. The bed is of the double-length type, so that the table has no overhang, even when the center line of any spindle is at the extreme end of the table.

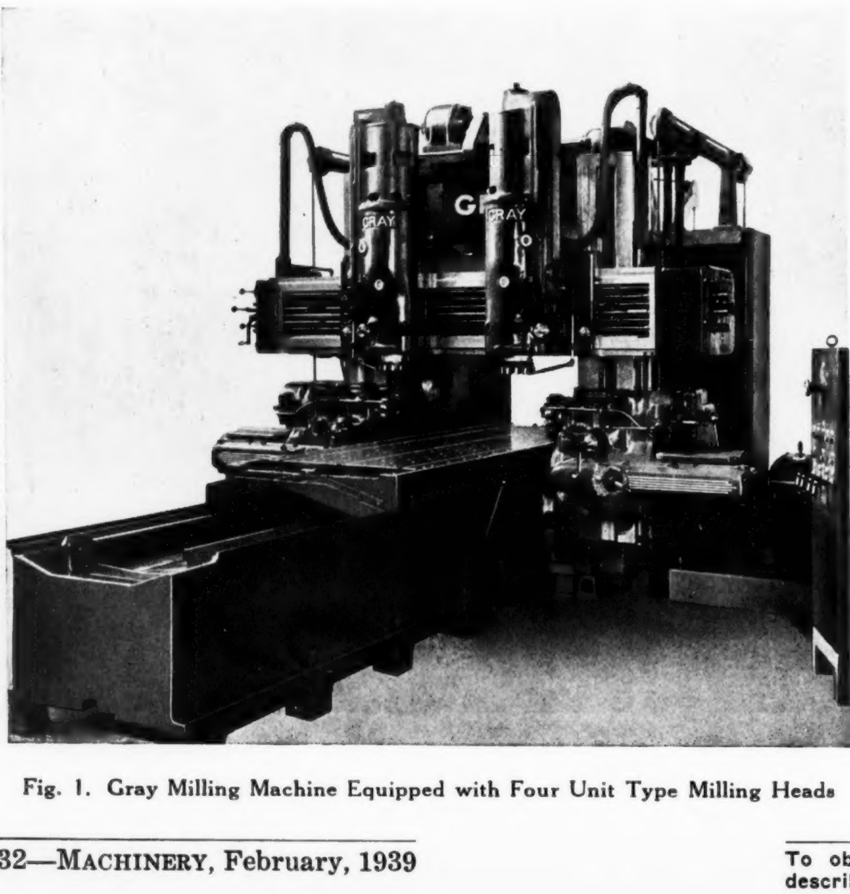


Fig. 1. Gray Milling Machine Equipped with Four Unit Type Milling Heads

The table is driven by means of the "stub shaft" spiral-gear drive shown in Fig. 3. The self-locking spiral gear of this drive meshes directly with the table rack, thus insuring a smooth motion. The stub shaft is driven by hardened and lapped alloy-steel hypoid gears. Both the hypoid gears and the spiral gear run in an oil bath. The rail of the machine is automatically leveled before clamping, whether it is equipped for hand clamping or automatic power-clamping. The weight of the rail milling head is carried by spring-loaded, anti-friction rollers which relieve the guide ways of the weight, so that they can be moved with comparatively little effort. This construction also eliminates wear on the guide ways and gibs.

The milling heads are individual units, each unit being driven by its own self-contained motor. This arrangement permits two or more heads to be operated at different speeds at the same time. The heads can also be brought into action successively without changing speeds. Rail-heads of either the swiveling or the non-swiveling type can be furnished. This individual unit construction makes possible a very rugged spindle drive for the swiveling type heads. The standard spindle motor is of the alternating-current, two-speed, 10-H.P. type, mounted concentric with the spindle. The

To obtain additional information on equipment described on this page, see lower part of page 430.

motor drives the spindle directly through planetary gearing. Direct-current motors and motors of different horsepower ratings can be furnished.

A simple and compact arrangement of the planetary gearing affords eighteen spindle speeds in geometric progression, ranging from 10 to 500 R.P.M. for 60-cycle operation and from 8 to 420 R.P.M. for operation on a 50-cycle current. The speed can be changed at the head by means of two levers without stopping the motor. The spindle speed is indicated on a direct-reading speed plate. The rapid traversing and the feeding movements of the rail-heads, in either direction, can be controlled from the heads, as well as from either end of the cross-rail. The spindle can be "jogged" in either direction or its direction of rotation can be reversed instantly, making it practicable for use with a tapping chuck mounted in the head.

The standard quill travel of both rail-heads and side-heads is 10 inches. The standard milling feeds for the table, rail-heads, and side-heads are from 1/2 inch to 30 inches per minute. 52

Double-Spindle "Incolap" Gear-Lapping Machine

A new double-spindle, automatic, high-speed, "Incolap" gear-lapping machine, designed to correct the profiles of external and internal spur and helical gears, multi-thread worms and splines, to obtain silent operation, has been developed by Gear Processing, Inc., 6700 Grant Ave., Cleveland, Ohio. The primary function of this machine is to reciprocate the gear and its surrounding lap while the two are held in contact under suitable pressure for lapping the tooth profiles. For an internal gear, the lap is, of course, located inside the gear to be corrected.

"Incolap" Double-spindle Gear-lapping Machine

This machine is designed for high-speed work on gears not over 4 1/2 inches in diameter, and is equipped with a turntable having three work-holding arbors. The gear to be lapped is placed on the arbor at the loading position, and located by a fixture which can be quickly swung into position for this purpose. The gear is clamped in place on the arbor by a nut and C-washer. Pushing the starting button then causes the turntable to be indexed by air pressure counter-clockwise 120 degrees, so that the gear comes into position under the lap at the right. The two laps are then lowered, the lap at the right being lowered over the gear just placed in the fixture, while the lap at the left is lowered over the gear previously located under the lap at the right. Air cylinders that are adjustable for pressure apply sufficient torque to press the lap teeth against the gear teeth during the reciprocating lapping operation.

An abrasive mixture consisting of fine abrasive grain suspended in fluid is fed through the spindles to the laps. This fluid drains into a tank, from which it is recirculated. The reciprocating laps continue their motion for a predetermined number of strokes. The cylinders then reverse the direction of torque, so that the opposite sides of the gear teeth are pressed into contact with the corresponding sides of the lap teeth. This arrangement results in lapping both sides of the gear teeth. While the lapping operation is being performed, a new gear is located on the arbor ready for indexing into position for the first lapping operation. Thus the cycle is repeated, the gear operated upon by the lap at the right being moved to the lap at the left for finishing, while the gear finished by the latter lap is moved into the unloading position. 53

Aero Screw-Operated Press

The Aero Tool Works, 201 Weston Road, S., Toronto, Ontario, Canada, have developed a screw press for stamping, trying out dies, fitting and lapping die sets, compressing ceramics, etc. This press provides a straight-line movement for shearing punches into hardened dies. The movement is free from any springing action or error in alignment, so that the press insures a straight punch that can be ground all the way down and will still produce accurate work. This feature is particularly desirable in the case of progressive dies. With the hardened die fastened securely in position, the punch can be removed for hand work and replaced exactly in its former position. The die can be quickly blocked up on parallels to allow clearance for springs and cams, and to permit inspection of the punch action in the die, timing, etc.

The maximum pressure obtainable is 40 tons. The press parts that are required to withstand the most wear are made of bronze. A 2-inch hole is provided in the center of the ram for a punch-holder. The operating screw is 2 1/2 inches in diameter and the pitch is optional. The stroke of the press is variable up to 12 inches. The height is 72 inches, and the weight is 800 pounds. 54

Screw-operated Press Made by the Aero Tool Works

To obtain additional information on equipment described on this page, see lower part of page 430.

Fig. 1. Cincinnati Plain Automatic Milling Machine

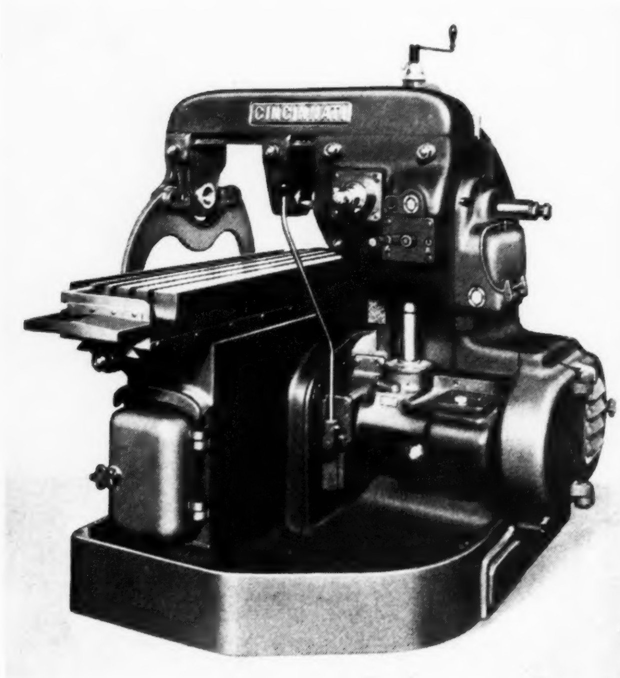


Fig. 2. Rear View of Milling Machine Shown in Fig. 1

Cincinnati Plain Automatic Milling Machines

A plain automatic milling machine, designed for the rapid production milling of medium size work, has been brought out by the Cincinnati Milling Machine Co., Cincinnati, Ohio. This machine is of the fixed bed type, and is available with a table travel of either 18 or 24 inches. It is particularly adapted for the manufacture of parts for business machines, hand tools, small firearms, sawing machines, washing machines, and small air-conditioning and refrigeration units, as well as medium-size automotive and aircraft parts.

The 5-H.P. motor employed gives these machines ample capacity for handling a large variety of work. Twenty spindle speeds, ranging from 30 to 1200 R.P.M., and sixteen feeds of from 1 inch to 40 inches per minute are available. An automatic spindle stop and a hydraulic backlash eliminator are provided. The driving motor, mounted on a hinged plate, is connected to the driving pulley by multiple V-belts. Both the motor and the drive unit are totally enclosed in the base of the headstock and are readily accessible through the motor compartment door.

The spindle speeds are changed by pick-off gears and a back-gear lever. The pick-off gears fit snugly over steep-angle ground tapers, and are driven by double keys. The gears are readily accessible, and are secured by large nuts to insure accurate alignment. Gears not in use are stored in a compartment at the rear of the headstock. The standard series of table feeds are also obtained by pick-off gears. The feed-gears not in use are shelved, out of the way of the operator, in the door of the feed change-gear compartment, located in the end of the bed.

The dog-controlled, automatic working cycles with intermittent feeds for the table, in either direction, permit accurate tripping of the table at the point of reversal within 0.005 inch. A dog-controlled power rapid traverse of 250 inches per minute is provided. As the rapid advance and rapid return and feed of the table are automatic and dog-controlled, the operator only has to load, start, and unload the work, making it possible for one man to attend several machines. 55

Inspector's Marking Hammer with Interchangeable Heads, and Billet-marking Hammer

Billet-Marker and Inspection Marking Hammer

The Quality Die Co., South Chicago, Ill., has recently added three new marking tools to its line of steel stamps and marking devices. The multiple-wheel billet-marking device, shown in the lower view of the accompanying illustration, is made in two models, for use as a sledge for stamping hot material, and for use with a sledge for stamping cold material. The third tool, shown in the upper view, is an inspector's marking hammer, having interchangeable heads, which eliminates the necessity for carrying a number of different hammers.

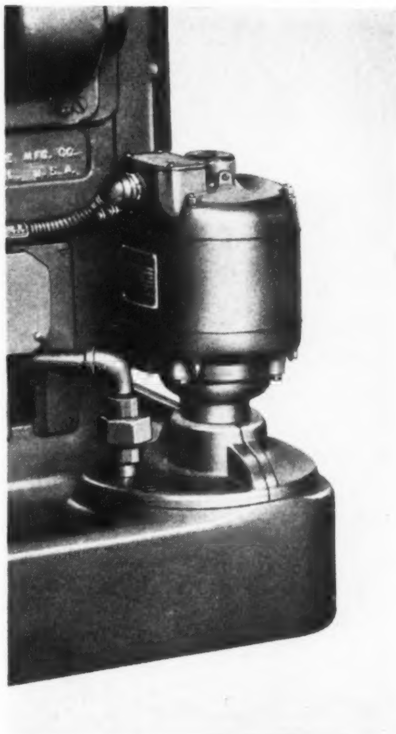
Figures or letters engraved on the wheels of the billet-markers are capable of marking on metal having a hardness up to 415 Brinell. The billet-marking devices are adapted for marking serial numbers or characters on products made from alloy steel, forgings, castings, etc., and are available in different sizes. 56

To obtain additional information on equipment described on this page, see lower part of page 430.

Brown & Sharpe Centrifugal Motorpump

The Brown & Sharpe Mfg. Co., Providence, R. I., has recently brought out a No. 205 centrifugal "motorpump" which has a submergence depth of 6 1/4 inches. With respect to performance, capacity, and electrical characteristics, this pump is identical to the No. 206 "motorpump" recently brought out by this company. It is particularly adapted for compact installations in machine bases where the height is restricted, and for use in shallow tanks for supplying coolant to machine tools and light machinery where dirt or abrasives may be present in the liquid.

The pump is fitted with a fully enclosed motor and grease-sealed ball bearings, but is available with special and regular motors of different types to suit most electrical installations. The stainless-steel shaft is integral with the motor. The aluminum-bronze impeller is of the open or non-clogging type and will deliver a moderate flow of liquid at a low head........57



Brown & Sharpe Motorpump Installed on a Milling Machine Base

Cullman Improved Drive for Machine Tools

Several new developments or improvements have been made recently in the machine tool drives built by the Cullman Wheel Co., 1344-1354 Altgeld St., Chicago, Ill. One of these is a drive for Cleveland automatic screw machines in the 7/8- to 6-inch capacity sizes, using motors from 2 to 15 H.P. This unit is similar to the lathe drive made by the company, with the exception that the gear-case on the new drive provides three changes in speed. This company's speed reducer and a heavy flywheel are also used with this drive for operating the feed-shaft of the automatic screw machine. The flywheel assists in applying additional pressure on the collet when locking the bars.

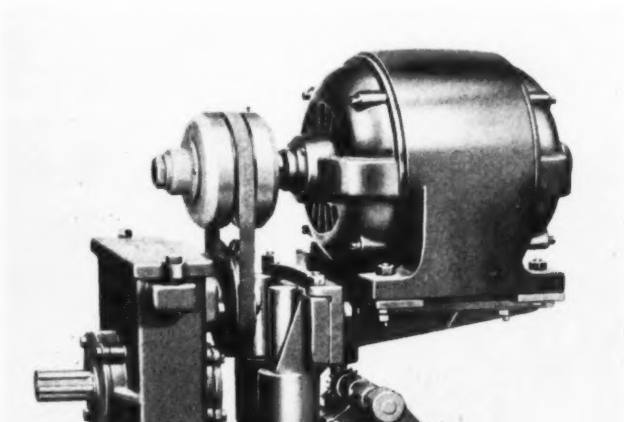
Another new development is a variable-speed reducer which is designed to be used with the regular speed reducer made by this company. It is made for motors from 1/4 to 3 H.P., and provides for variations in speed up to ratios of 2.8 to 1. The speed can be varied while the machine is in operation, a crank being used for raising and lowering the motor to change the speed......58

Ozalid Automatic Printing and Developing Machine

Three new printing and developing machines for duplicating drawings, which produce accurate copies with black lines on a white background, have been brought out by the Ozalid Corporation, 354 Fourth Ave., New York City. The production of white prints is accomplished automatically. The operator simply feeds the original to be copied and the sensitized material for the white print into the machine, which is driven by a 1/4-H.P. motor.

The machine first exposes the print to a mercury vapor lamp in the printing unit. The print then passes through the developing unit, where it is dry-developed by exposure to ammonia vapor, after which it is delivered either at the rear or the front of the machine in a dry condition, ready for use.

The Model E machine, shown in



Cullman Improved Drive Equipped for Varying Speed while Machine is in Operation

Ozalid Machine for Printing and Developing Prints with Black Lines on a White Background

To obtain additional information on equipment described on this page, see lower part of page 430.

the accompanying illustration, is designed to meet the average requirements for technical white prints. It will handle all Ozalid sensitized materials up to 42 inches wide at printing speeds up to 30 linear inches per minute.

The new high-speed Model A machine, developed for making engineering and architectural white prints, will make prints up to 42 inches wide at a speed of 20 feet per minute. A small machine, known as the Model D, is especially intended for the economical duplication of specifications, office records, reports, correspondence, small drawings, etc. Accurate copies of such forms can be made with blue, black, or maroon lines on a white background. 59

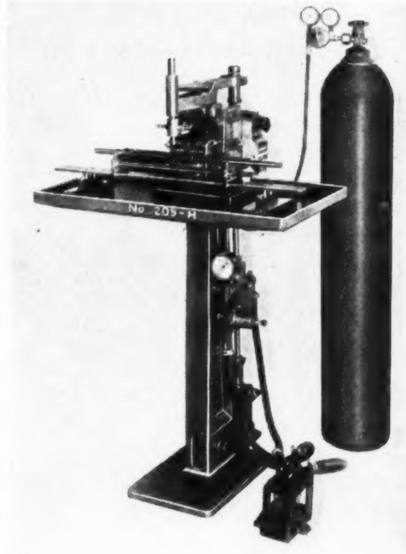
Littell Self-Contained Feeding and Straightening Unit

A feeding and straightening machine comprising a five-roll straightener, an oiler and a power-driven cradle reel has been brought out by the F. J. Littell Machine Co., 4149 Ravenswood Ave., Chicago, Ill. This is a completely self-contained unit which straightens heavy material and feeds it a predetermined length directly into the punch press. It can be moved to any press, and can be set at the front, back, or side of the machine. The operator can trip the machine by means of a remote control station, located at any convenient point. This unit is especially adapted for feeding material into toggle drawing and double-action presses.

The length of feed on the machine illustrated can be varied from 0 to 25 inches. Other feed lengths can also be furnished. The machine will handle stock up to 1/16 inch thick by 25 inches wide, or heavier stock in narrower widths. All feeding and straightening rolls are diamond-knurled to give greater pulling power. The machine is driven by its own 2-H.P. motor, and has a clutch similar to that of a punch press, so that it makes only one complete feed when tripped.

The reel used with this unit is a standard No. 30 cradle type, and is equipped with a variable-speed drive. It will handle coils up to 3000 pounds in weight, and is driven by a 1-H.P. motor equipped with a magnetic brake and control mechanism. 60

Eisler Electric Spot-Welding Machine



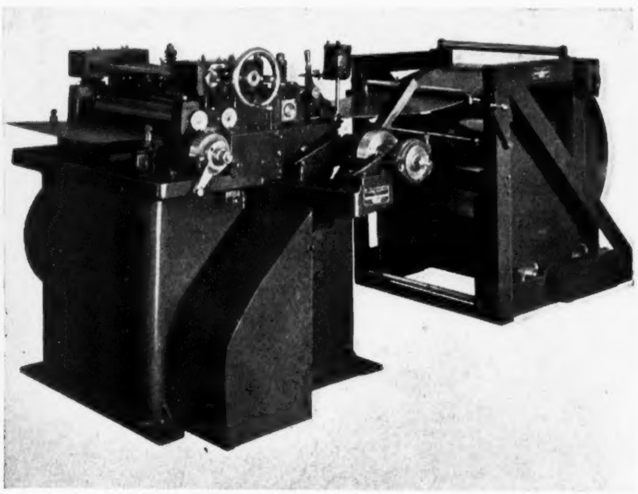
Eisler Electric Spot-welding Machine Equipped to Use Hydrogen Gas to Prevent Oxidation

An electric spot-welding machine equipped with an automatic hydrogen gas economizer for use in welding molybdenum, nickel, and similar metals, has been placed on the market by the Eisler Engineering Co., Inc., 750 S. 13th St., Newark, N. J. With this machine, hydrogen gas is directed to the spot where the welding takes place to prevent oxidation.

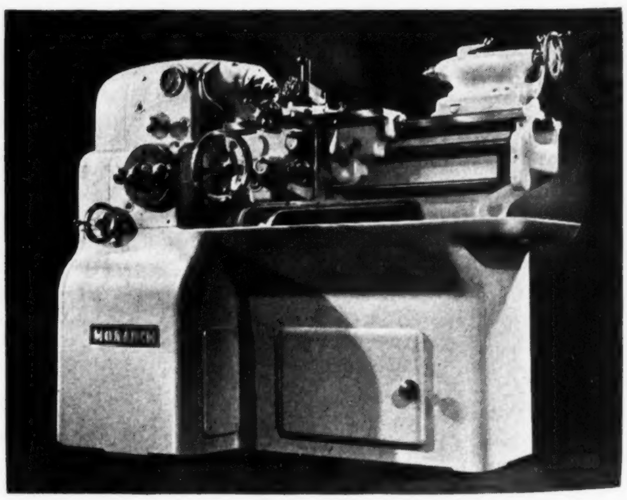
The automatic gas economizer and shut-off valve are so arranged that as soon as the weld is completed, the gas is cut off, so that it burns only during the actual welding operation. When the welding tips make contact with the work and the weld is made, the valve permits a small amount of gas to be directed over the spot welded. This not only prevents oxidation, but in many cases also prevents the material from becoming brittle. The particular machine illustrated is an air-operated vertical plunger type with a capacity of 5 kilovolt-amperes. Machines of this type are made in sizes up to 250 kilovolt-amperes capacity. 61

Monarch Sensitive Precision Lathe

The Monarch Machine Tool Co., Sidney, Ohio, has introduced on the market a 10- by 20-inch sensitive precision lathe that is of entirely different appearance and operation from any previous lathe of the sensitive precision type. This lathe was developed as the result of research conducted among users of tool-room lathes, which indicated that a large



Littell Self-contained Unit for Straightening and Feeding Flat Stock to Punch Press



Monarch 10- by 20-inch Sensitive Precision Lathe Developed for Tool-room Use

To obtain additional information on equipment described on this page, see lower part of page 430.

part of the work done on 12-, 14-, and 16-inch geared-head tool-room lathes could be more efficiently handled on a 10-inch lathe with a maximum 2-H.P. capacity.

The new lathe was designed to meet these requirements and to perform all the functions of which the larger sizes of tool-room lathes are capable, as well as additional ones. It is also claimed that it will, through improved arrangement of the controls and a wider range of spindle speeds, accomplish such work in less time, with greater accuracy, and with less fatigue to the operator.

The advantages claimed for the machine include an almost unlimited range of gearless, stepless spindle speeds for both forward and reverse; a wide range of threads and feeds through an enclosed quick-change gear-box, operated by one hand; carriage held in secure alignment with the ground bed-ways by self-aligning ball bearings, mounted on eccentric studs; use of anti-friction bearings throughout; practically automatic lubrication; and three-point bearing on the floor, insuring accurate alignment. 62

Hydraulic Punching Units Equipped with Strippers

A single punch unit with which automatic stripping is performed entirely through the action of balanced springs, and a multiple punch unit which is available either for hydraulic or mechanical stripping, have been developed by the Progressive Welder Co., 737 Piquette, Detroit, Mich. These new units are designed for use either individually or in groups for multiple punching. Both types can be operated either by a motor-driven pump or an air-hydraulic booster for pressures up to 2000 pounds per square inch, the booster being used for higher pressures.

An installation for an automobile plant consisting of twenty of the mechanical stripping units, mounted in a fixture, for punching thirty-six holes in an automobile hood top is shown in the accompanying illustration. The use of these individual units permits rearrangement to suit changes in car design. 63

Spindle Pre-Selector for Bardons & Oliver Turret Lathes

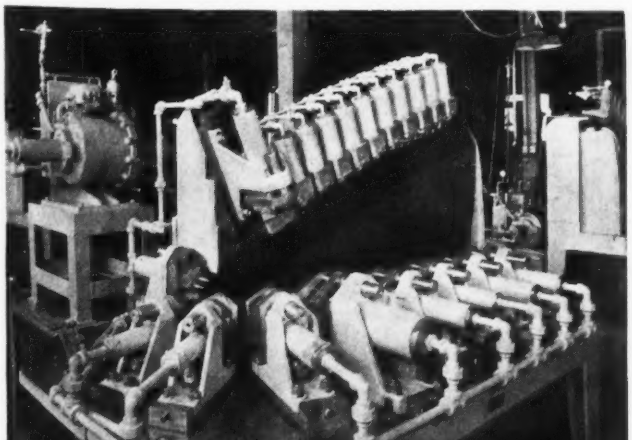
Bardons & Oliver, Inc., Cleveland, Ohio, have recently developed a single-lever spindle-speed pre-selector for their No. 5 and No. 7 turret lathes. This device enables the operator to select quickly the most efficient spindle speed for each operation, and assists him in making the necessary changes in speed as rapidly and with as little effort as possible.

The single control lever just to the right of the speed pre-selector can be moved directly and quickly from the forward to the neutral or brake position or from the forward to reverse position without changing the spindle speed. As the lever is moved from the forward to the neutral or brake position, it passes a point at which it can be depressed slightly. An almost effortless depressing movement of the lever at this point operates the valve of a hydraulic system. The hydraulic system instantly operates the sliding gears to give the spindle speed for which the dial of the speed pre-selector has been set.

With this arrangement, the drum or dial of the pre-selector can be set to any spindle speed available while the machine is taking a cut. As soon as the cut is completed, the operator can shift to the new speed almost instantly without moving his eyes from the work. The spindle speeds are indicated on a dial used in conjunction with a chart that gives the cutting speeds for work of corresponding diameters.

The drum of the pre-selector has four small spokes to facilitate setting it to the desired speed. The dial is provided with removable clips for numerals which can be used to indicate the number and sequence of speeds desired for the various machining operations on a piece of work. This arrangement is of great advantage in high-production work, as the operator only has to turn the pre-selector to the successive number after a change in speed has been made, to obtain the correct speed for the next operation the instant it is required.

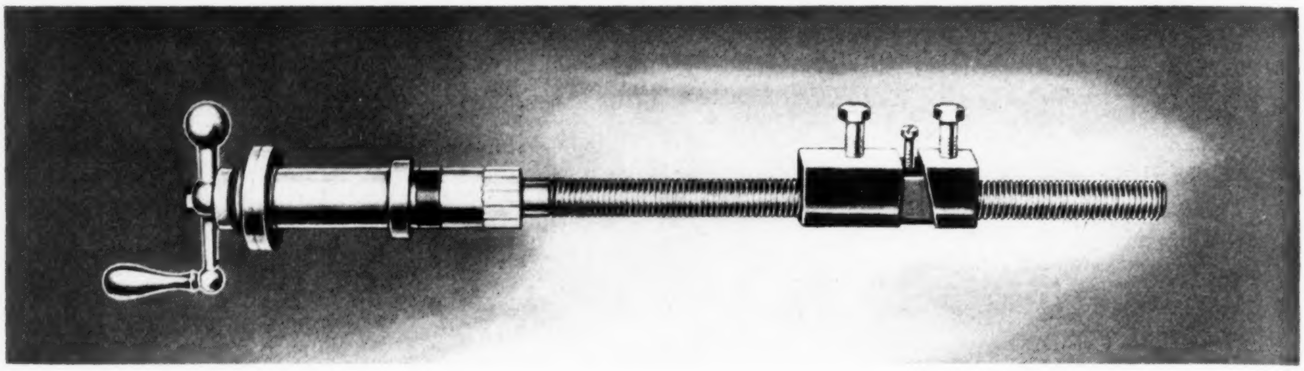
The following equipment is provided for determining quickly the correct spindle speed for any machining operation. Graduations representing surface speeds in feet per minute are located on the stationary cover of the unit, and on the movable member or drum is a plate which gives the spindle speed. Below



Fixture with Twenty Hydraulic Punching Units Made by Progressive Welder Co.

Bardons & Oliver Spindle Speed Pre-selector for Turret Lathes

To obtain additional information on equipment described on this page, see lower part of page 430.



Cross-feed Screw and Nut that can be Adjusted for Wear, Used on Lathes Built by the American Tool Works Co.

this plate is a chart showing diameters opposite the cutting speeds. The cutting speed chart gives all the diameters corresponding to one spindle speed that fall within a definite range of surface cutting speeds.

Assuming that a forging 10 inches in diameter is to be machined at a cutting speed of from 100 to 125 feet per minute, the operator simply revolves the drum and follows the line representing work 10 inches in diameter until one particular spindle speed is found which will give a corresponding surface speed of about 110 feet per minute. 64

Ajax 2000-Ton Forging Presses

Forging presses of 2000-ton capacity, like the one illustrated, were built recently by the Ajax Mfg. Co., Cleveland, Ohio, and are in operation in the forge plants of two large automobile companies. They are being used for forging rear-axle ring gears and a variety of smaller forgings produced in multiples from pre-rolled blanks.

These presses are of special interest, as they are the largest built by the company up to the present time, and are believed to be the most powerful mechanical forging presses in operation in this country on the type of work described. The complete machine weighs 260,000 pounds, and even though partially disassembled, required special railroad gun trucks for its transportation.

For work requiring moderate operating speeds, these presses are built with two-stage reduction gearing. Single-stage gearing is used when higher speeds—over fifty strokes per minute—are required. In actual production, one of these presses, with single-stage gearing, has operated on a schedule of 740 strokes per hour, or an average of more than twelve clutch engagements per minute. 65

Forging Press Weighing More than 250,000 Pounds, Built by Ajax Mfg. Co., for Forging Rear-axle Gears

Improvements in American Lathes

The cross-feed screws of all lathes built by the American Tool Works Co., Cincinnati, Ohio, are now hardened by a process developed to eliminate distortion and produce a surface hardness that is highly resistant to wear.

In order to further stabilize the cross-feeding mechanism, a heat-treated bronze, two-piece, automatically oiled cross-feed nut is employed that is provided with means for compensating or adjusting for wear. The combination of hardened screw and adjustable bronze nut insures confining the wear to the nut, where it can be easily compensated for by means of the adjustment provided. This arrangement makes it possible to maintain a snug fit between the screw and the nut. 66

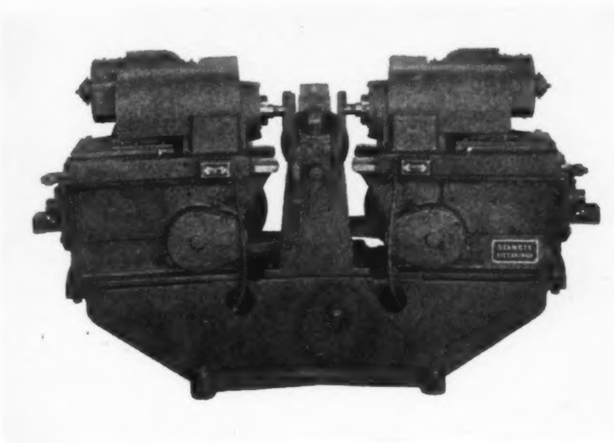
Stamets Double-End Valve-Facing Machine

A machine for boring the water way and back-facing the seats in valve bodies and for facing disks in sizes from 3/4 inch to 2 inches has been developed by William K. Stamets, Jenkins Arcade Bldg., Pittsburgh, Pa. The machine consists of a base supporting two boring heads that swivel, so that the heads can be set in line or at an angle to each other.

Mounted in each carriage is a boring spindle which carries an arbor and a tool-holder arranged to provide a compound eccentric movement, so that when the arbor is rotated in the spindle, the cutting tool moves radially with respect to the center line of the spindle. This arrangement provides an accurate balance of the rotating parts, so that high speeds, such as are required for Carboloy tools, can be employed.

A slide is mounted on each carriage on which there is a nut that engages the rear threaded portion of the arbor, so that when the slide is moved, it rotates the ar-

To obtain additional information on equipment described on this page, see lower part of page 430.



Stamets Double-end Valve- and Disk-facing Machine

Oilgear Precision Speed Control Transmission

bor, thus providing cross-feed for the cutting tools. Both the carriage and the carriage slide are operated by means of a drum cam. Provision is made for facing flat or slightly conical valve seats. Roughing and finishing cuts are taken in back-facing the valve seats. 67

Oilgear Precision Variable-Speed Drives

Fluid-power variable-speed drives designed to give precisely the driving speed desired, regardless of fluctuations in the speed of the drive to the pump end of the unit resulting from variations in the load, oil temperature, running fits or power-line currents, have been placed on the market by the Oilgear Co., 1302 W. Bruce St., Milwaukee, Wis.

The variable-speed drive shown in the illustration comprises a standard Oilgear fluid-power transmission with a micro Servo-motor stroke-control cylinder which adjusts the pump stroke to give exactly the required hydraulic motor speed. Oil is admitted to this cylinder by a pilot valve actuated by a small differential unit which continuously coordinates or compares the hydraulic motor speed with time periods determined by a small synchronous motor or pendulum, or with the speed of any desired master unit.

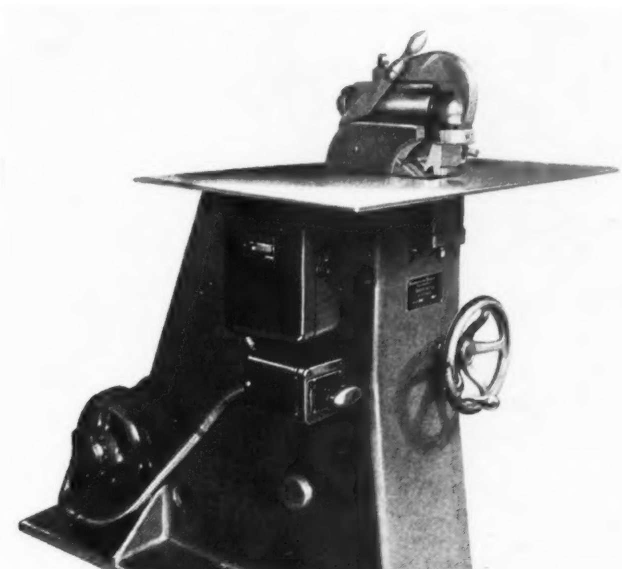
These new drives are adapted for driving spinning machinery through a repetitive cycle of gradually increasing speed and the various units of continuous rolling mills, paper machines, or any type of processing machines. The various units of these machines can be driven by a group of precision drive units. One unit, acting as a master, may control each of the other units, either by parallel control or by having each unit act as a master to the unit next in sequence in the process, the latter method being termed series or chain control. In either case, the speed ratios between the successive units are individually adjustable, and all units in the group will increase or decrease their speed in exact proportion to the changes in the speed of the master unit.

Each Oilgear transmission in a group receives its power from any source or drive; these drives are not required to hold their speed constant, as the control on each unit holds its hydraulic motor at exactly the preset speed. One of these units, when driven by an ordinary induction motor or lineshaft, for example, will drive its load at any desired speed, maintaining either a constant or an adjustable speed. 68

Improved "Erco" Sheet-Metal Former

An improved Model HD "Erco" sheet-metal former which provides a means of forming or flanging the edges of sheet metal when the contour is so irregular that hand work would ordinarily be necessary has been brought out by the Engineering & Research Corporation, Riverdale, Md. Forming or flanging is performed on this machine through the oscillation of a short brake against a holding-down tool at a speed of 250 and 500 strokes per minute. The total angle through which this brake oscillates is controlled by a handwheel at the front of the machine.

Smooth and well formed edges are produced by bringing up a small part of the sheet at each up stroke of the brake head. The narrow working surface is an advantage in that small radii and complicated shapes can be readily formed without wrinkling the flange. The forming work is done quickly by the rapidly oscillating brake head.



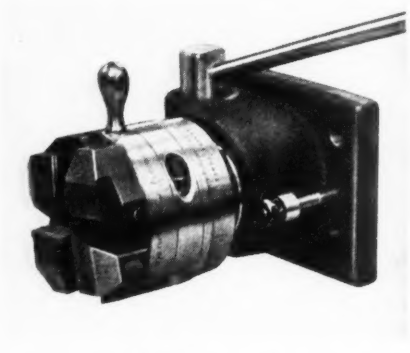
"Erco" Sheet-metal Former Brought out by the Engineering & Research Corporation

To obtain additional information on equipment described on this page, see lower part of page 430.

The work is fed by hand, being released after each up stroke and reclamped automatically.

This machine was developed originally for the aircraft industry for use in forming metal ribs, tank ends, fuselage, and other aircraft parts which were formerly hand-shaped over forms. Recent improvements in design, however, adapt it for use in industries fabricating heavier parts from sheet metal. This machine will form straight, flared, half-round, offset, beaded, and reverse flanges or straight, curved, or irregular-shaped flat or crowned sheet metal. Outside edges of circular disks, as well as inside edges when the radius of the inside circle is not less than 5 inches, can be formed.

It is possible to work metals such as soft steel, semi-hard steel, stainless steel, spring or soft brass, copper, zinc, aluminum, Monel metal, and heat-treated duralumin alloys in cases where the number of parts does not justify the expense for power press and die equipment. 69



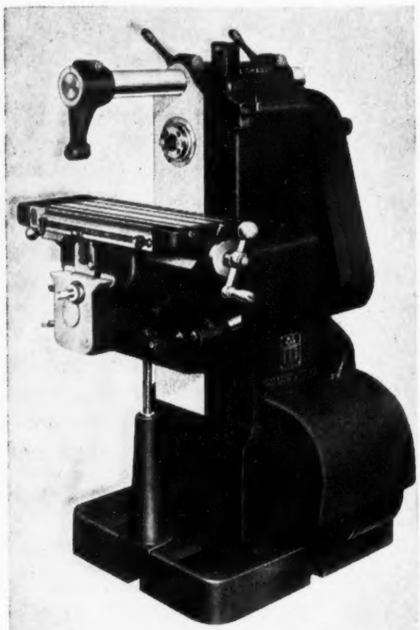
Landmatic Die-head with Hand-feed Adapter

Brown & Sharpe Small Size Milling Machine

A No. 0 plain milling machine, designed primarily for use in shops where medium-light cuts are required for job-lot or small-quantity production, is a recent addition to the line of milling machines built by the Brown & Sharpe Mfg. Co., Providence, R. I. This machine is also adapted for manufacturing small parts in tool-rooms and experimental laboratories and for instruction in vocational schools and colleges. It is similar in design to the No. OY plain milling machine, but does not have the semi-automatic table. It can be furnished as a motor-driven unit or with an overhead countershaft drive.

The table has a working surface 22 1/2 by 18 13/16 inches, a longitudinal feed of 18 inches, and a hand transverse adjustment of 6 inches. A 14-inch vertical adjustment of the knee is obtained by hand. There are eight changes of spindle speed, in two series, ranging from 120 to 1350 R.P.M. Eight changes in feed are available for each spindle speed, making a total of sixty-four changes in feed, ranging from 5/16 to 79 5/8 inches per minute.

A coolant tank having a capacity of 4 1/2 gallons is cast in the base of the machine. The motor-driven machine has a constant-speed motor mounted on the side of the column beneath the guard. The 1-H.P. motor can be furnished for the usual voltages in alternating or direct current, and runs at a speed of 1200 R.P.M. A stop-start push-button station is located on the machine column. All electrical controls are mounted in a compartment at the rear of the machine. 70



Brown & Sharpe No. 0 Plain Milling Machine with Screw Feed

Hand-Feed Adapter for Landmatic Die-Heads

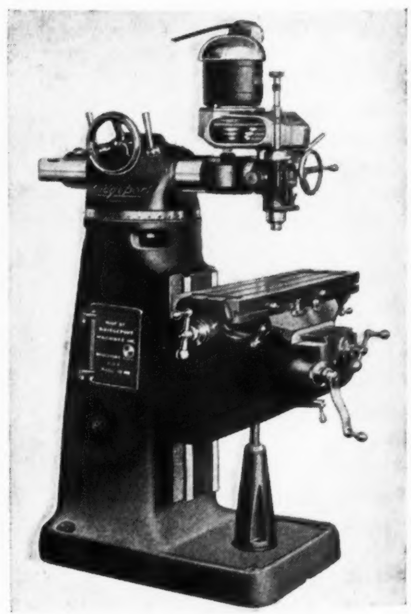
The Landis Machine Co., Inc., Waynesboro, Pa., has brought out a new type sliding adapter designed to facilitate the application of Landmatic die-heads to heavy-duty turret lathes. This adapter not only permits a floating action for the die-head, but also provides a gear mechanism for starting the die-head on the work by hand.

The forward or thread starting movement of the die-head is accomplished through an intermediate gear mechanism contained within the adapter. A rack gear is milled axially along the peripheral surface of a bushing to which the die-head shank is fitted. A pinion gear, which engages the rack gear on the bushing, is fitted with a long handle for actuating the movement of the bushing. The distance the bushing travels is controlled and the die-head is automatically opened by a lug which extends through a longitudinal slot in the adapter housing. A threaded stud, anchored in the base of the housing, passes through a hole in the lug and is fitted with lock-nuts which can be adjusted to limit the travel of the bushing.

The use of an adapter of this type assures a perfect starting action for the head, regardless of the weight of the turret and carriage. The lead of the thread is, therefore, controlled more accurately and the quality of the thread is improved. 71

Bridgeport Turret Milling Machine

An outstanding feature of a new turret milling machine developed by Bridgeport Machines, Inc., formerly the Bridgeport Pattern & Model Works, 52 Remer St., Bridgeport, Conn., is the provision for moving the milling spindle over a large area and for setting it to any angle. Provision has also been made for a slotting attachment on the opposite end



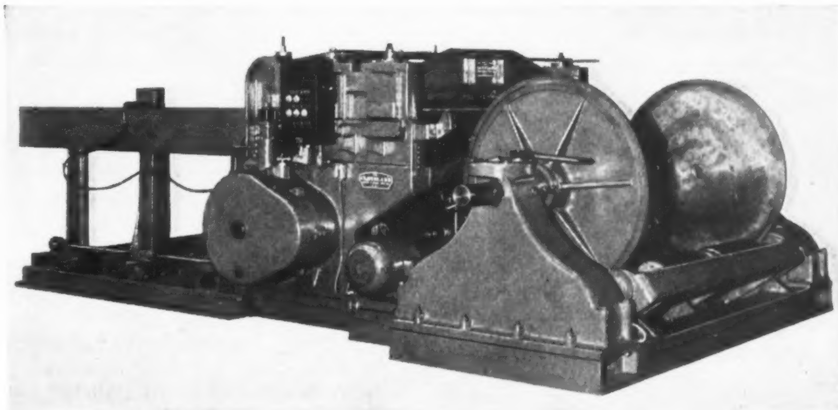
Turret Milling Machine Built by Bridgeport Machines, Inc.

To obtain additional information on equipment described on this page, see lower part of page 430.

of the mounting arm, making it possible to use the machine for two different operations.

Angular settings in one plane are obtained by turning the handwheel that controls the keyed over-arm. The table, knee, and saddle locks are located at the front of the machine for convenient operation. Large graduated dials, 3 1/4 inches in diameter, facilitate accurate setting. The keyed over-arm is 15 inches in diameter, and is equipped with a worm-wheel control for the angular settings.

The machine has a longitudinal feed of 20 inches and a cross-feed of 9 inches. The vertical feed of the knee is 16 inches, and the maximum distance from the spindle to the table is 17 inches. The maximum distance from the spindle to the column is 19 1/2 inches. The table is 9 by 32 inches. The master milling unit has six spindle speeds ranging from 275 to 4250 R.P.M. The quill travel of this unit is 3 1/2 inches. A rack and worm feed is provided for drilling and boring, and there is a micrometer depth stop with 0.001 inch graduations. The milling unit is driven by a 1/2-H.P. heavy-duty motor. 72



Cleveland Automatic Shear Arranged with Uncoiler, Leveler, and Feed-rolls

Cleveland Automatic "Cut-to-Length" Shear

An automatic "cut-to-length" shear with an uncoiler, five-roll leveler, and feed-rolls has been designed by the Cleveland Punch & Shear Works Co., 3917 St. Clair Ave., Cleveland, Ohio, for cutting coil stock into pieces of the desired length. The shear will handle stock from 24 to 78 inches wide, and is equipped with a discharge table at the rear, which holds the sheet in position until the piece is cut off. When the sheet is cut off, the discharge is automatically tripped, dropping the sheet into a "buggy," which is placed in the stacker.

The shear is arranged for a speed of 60 strokes a minute with a feed of 200 feet per minute. The number of cuts per minute is, of course, determined by the length of the feed. The electrical control consists of a single push-button panel, with selectors for hand, semi-automatic, and automatic operation. The panel also includes a button for "inching" the sheet either forward or backward.

The stacker unit, or run-out table, is adjustable to accommodate the width of the sheet, and is arranged for a feed of from 6 to 120 inches, although the length of feed can be increased by extending the stacker guides on which the timer is mounted.

The heavy-duty uncoiler is of the cradle type, and is so designed that, as the coil decreases in size, all the rollers continue to bear on the outside of the coil. The rollers are covered to prevent marring or scratching the material. The control buttons connect this unit with the rest of the mechanism, so that the uncoiler runs automatically with the feed mechanism. A limit switch located directly behind the uncoiler prevents this unit from over-traveling. 73

Tangent Bending Machine Developed by the Steelweld Division of Cyril Bath & Co.

Bending Machine for Forming Refrigerator Cabinets

The Steelweld Division of Cyril Bath & Co., Cleveland, Ohio, has developed an unusual metal-forming machine for use in the manufacture of refrigerator cabinets. This machine can also be applied to other bending work requiring flanges, T-sections, channel-shaped members, or tubing to be formed into curved sections with a minimum of distortion or change in the cross-sectional shape of the material or wrinkling of its surface.

In forming the corner of a refrigerator case or cabinet, the machine shown in the illustration makes a tangent bend in 18-gage material having a double fold on the forward edge that is 1 inch deep and a rear flange that is 3/4 inch deep. The cabinet produced varies from 24 to 36 inches in width and has a uniform depth of 18 inches. A production of 120 cabinets an hour, involving the making of two tangent bends, has been obtained with this machine.

The material formed or

To obtain additional information on equipment described on this page, see lower part of page 430.

bent on the tangent bender has a very fine planished appearance, both on the flanges and on the two curves composing the crown of the refrigerator. The bending operation is performed by rolling a guided flat shoe around the part being formed, the material being encased while the bending operation is in process. 74

Gisholt Collet Chuck with Quick-Change Pads

The Gisholt Machine Co., 1209 E. Washington Ave., Madison, Wis., has developed a new line of collet chucks of improved design in capacities up to 2 1/2 inches in diameter for its ram type machines, and up to 4 1/4 inches in diameter for its high-production machines. The pads of these new collet chucks can be removed in less than one-third the time formerly required, and with much less effort, the operation of removing a set and installing a new one being accomplished in two minutes. It is only necessary to slip off the light aluminum chuck guard, after loosening a thumb-screw, and take out the Allen cap-screws that hold the pads in place.

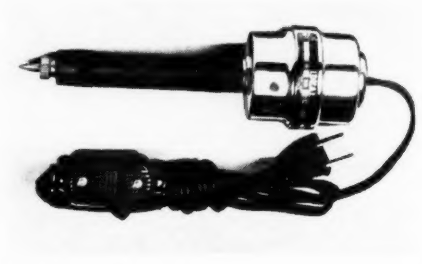
This collet chuck is of the push-out type, and has a four-jaw master collet with four ground pads which accurately center the bar material. The hardened-steel collet hood is bolted and keyed directly to the American Standard A-1 spindle nose, and the master collet is keyed to the collet hood. Holes through the collet hood permit the removal of the pad screws and the changing of the collet pads without removing the collet hood from the spindle.

The collet pads are located in an accurately ground groove. They are furnished to fit any size or shape of bar stock, including round, square, and hexagonal. All collet pads are ground on the outside, and pads for round stock are ground on the inside after hardening. The hood of the collet chuck is so designed that only a small area of the rotating part of the chuck extends through the guard, making it safer for the operator. 75

Gisholt Collet Chuck Equipped with Quick-change Pads

Electric Marking Hammer

An electric marking hammer that makes 7200 cutting strokes per minute and is designed for marking practically all materials, including ordinary metals, is a new product of the Ideal Commutator Dresser Co., 1011 Park Ave., Sycamore, Ill. This tool is available with a special diamond point for permanently marking tools, metal products, and parts for identification. It can be used for marking steel, bronze, brass, marble, tile, glass, porcelain, wood, Bakelite, etc. The connecting plug can be inserted in any 110-volt alternating-current 60-cycle light socket. 76

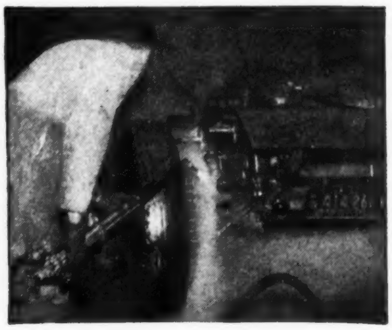


Electric Marker Brought out by the Ideal Commutator Dresser Co.

Oakite Self-Lifting Steam Gun

An improved steam gun for cleaning purposes has been developed by Oakite Products, Inc., 14 Thames St., New York City. This new gun automatically lifts the cleaning solution from the floor level to a height of over 10 feet without the aid of pumps, injectors, gravity feed, or other auxiliary means, and delivers an effective wet spray on the surfaces to be cleaned. All that is needed to operate the gun is the steam and solution hoses, steam supply, and an open-top drum or other solution container. In addition to being self-lifting, this new steam gun is lighter and easier to use than previous models.

The gun is manufactured in two sizes. It is equipped with an air-cooled handle. The smaller unit is 3 1/2 feet long, weighs 5 3/4 pounds, and is designed for cleaning automobiles, trucks, tractors, and similar equipment, as well as machinery and floors in metal-working plants. The larger unit is 7 1/2 feet long, weighs 13 1/4 pounds, and is designed for use on the heaviest steam cleaning operations. 77



Oakite Steam Gun Used in Cleaning Automobile Parts

Stanley Contour Grinder

The Electric Tool Division of the Stanley Works, New Britain, Conn., has brought out a new toolmaker's and diemaker's high-speed contour grinder, designated the No. 150, which is adapted for finishing dies, gages, templets, and parts of special shapes. This tool is driven by a 3/8-H.P. universal motor having a speed of 1800 R.P.M.

The top of the work-table is 12 by 12 inches. The motor is held directly under the work-table, and can be adjusted to an angle of 45 degrees. Mounted tool points with shanks up to 1/4 inch and wheels or rotary files

Stanley High-speed Contour Grinder for Tool-room Work

To obtain additional information on equipment described on this page, see lower part of page 430.

can be used in this machine with their ends projecting through the opening in the table top. Complete equipment includes a motor, work-table, light fixture, chuck, arbor, an assortment of mounted points and rotary files in a wooden block, and a 6-foot extension cord. 78

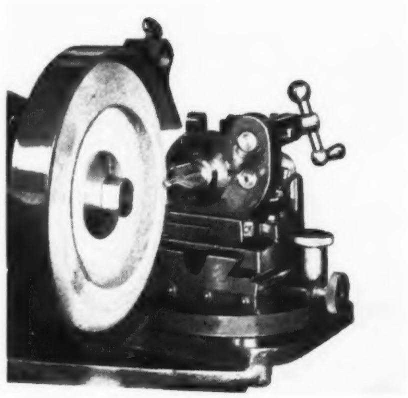
Covel Dual-Drill Grinding Attachment

Dual drills, which drill "two-diameter" holes in one operation, are used in many manufacturing operations. The adoption of these drills has been retarded, however, because of the difficulty of sharpening and reconditioning them. With this in mind, the Covel Mfg. Co., Benton Harbor, Mich., has designed a dual-drill attachment for grinding dual drills, center drills, and counterbores.

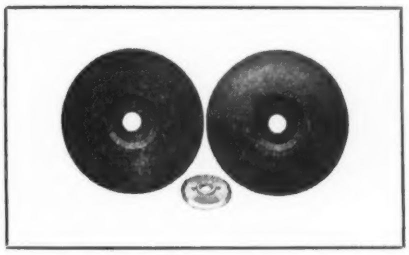
The manner in which this equipment functions when mounted on a Yankee twist drill grinder is as follows: The drill is inserted in the spindle of the attachment after the grinding wheel has been dressed to the proper shape and size. The drill is then positioned by an indicating finger, after which the attachment is turned by hand, so that both lips of a two-lip drill are ground the same. A cam regulates the clearance and throw of the drill. This cam is geared in a 2 to 1 ratio to the main spindle, so that the camshaft revolves twice as fast as the main spindle to provide the movement required for grinding the two drill lips. The dressing of the grinding wheel is accomplished by a diamond mounted in the spindle, using the adjustments on the cross-slide.

The circular base of the attachment can be revolved, so that the wheel can be dressed to any angle. In grinding the clearance on the drill, the cam action moves the drill toward the grinding wheel in two directions, so that clearance is ground both on the small diameter and on the cutting edge. Three-lip and four-lip drills can be ground with this attachment by changing the gearing ratio between the camshaft and the main spindle.

This attachment will grind center drills to fit centers drilled in a shaft and so that both lips are exactly alike. Although the attachment is made primarily for use on a Yankee twist drill grinder, it can be employed on other grinding machines equipped with a cup-wheel 10 inches in diameter. It has a capacity for grinding drills up to 1 3/8 inches in diameter. 79



Covel Drill Grinding Attachment for Grinding Dual Type Drills



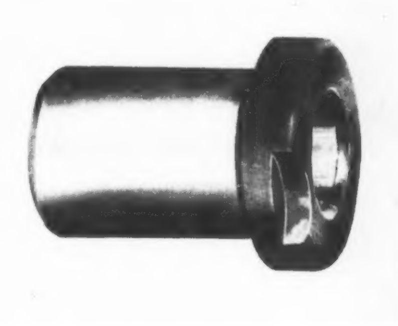
Rubber Sanding Pads Made by the United States Electrical Tool Co.

Flexible Rubber Sanding Pad

The United States Electrical Tool Co., Cincinnati, Ohio, has brought out a new "three-in-one" flexible, non-breakable rubber sanding pad in 5-, 7-, and 9-inch sizes. This pad is of molded rubber, and can be used for feather edging, flat sanding, or leveling. All three sizes of pads fit one holder, which can be used in any sander made by this company. These sanding pads have a flat surface for sanding flat work, and a curved surface for sanding curved surfaces and for feather edging. 80

Black & Decker Light-Weight Electric Drill

The Black & Decker Mfg. Co., Towson, Md., has recently added to its line of portable electric tools a new 3/16-inch drill designated the "Hornet." This compact tool has the high speed, power, and strength required for continuous production service on aircraft and light industrial work. It weighs only 34 ounces, has a splined gear mounting, ball bearings, screened air inlets, fan, new grip type switch, and a universal motor, operating at a speed of 3700 R.P.M., with an optional speed of 5200 R.P.M. 81



Drill Bushing with Honed Finish, Made by Universal Engineering Co.

Drill Bushing with Honed "Super-Finish"

The Universal Engineering Co., Frankenmuth, Mich., has recently made two improvements in its line of drill bushings. The bores of these bushings are now honed to a "super-finish," which improves the wearing qualities of the casehardened surfaces. A higher degree of accuracy in the roundness and straightness of drilled holes is said to be obtained by the use of these super-finished bushings.

Another improvement is the application of the new "Black Dome" process, a treatment which gives the bushing head a jet-black appearance and is claimed to reduce galling when no lubricant is employed. 82

Jacobs Improved Chuck with Fluted Sleeve

The Jacobs Mfg. Co., Hartford, Conn., has just brought out a new chuck with a fluted sleeve which represents a material improvement over the previous knurled-sleeve models.

Jacobs Chuck with Improved Fluted Type Sleeve

To obtain additional information on equipment described on this page, see lower part of page 430.

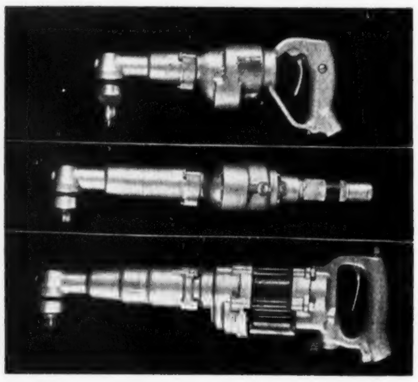
The new sleeve is internally ground on three diameters after heat-treatment, to accurately fit the body of the chuck, thus improving the balance. As the sleeve fits the body very closely, the nut that operates the jaws is accurately centered, thus improving the accuracy of the chuck. The new sleeve provides a better grip and one that is easier on the operator's hands. 83

Rotor Right-Angle Drilling and Nut-Setting Tools

A new line of air-driven right-angle tools has been brought out by the Rotor Tool Co., 17325 Euclid Ave., Cleveland, Ohio, in a range of types and sizes suitable for drilling holes from 1/4 to 9/16 inch in diameter; driving screws in sizes from No. 8 wood screws to 1-inch machine screws; and setting nuts in sizes from 1/4 to 5/8 inch. The malleable-iron angle head casings are bolted directly to the gear-case, and are equipped with ball bearings to take the thrust. Two roller bearings are provided for the pinion and the spindle gear.

The upper view in the accompanying illustration shows a Rotor right-angle drill with chuck; the center view, a right-angle nut-setter with long attachment and single positive clutch; and the lower view, a right-angle nut-setter with long attachment and double adjustable clutch.

Three types of clutches are available for setting nuts and driving screws—the single positive clutch, attached to the angle driving spindle; the new Rotor triple-action impact clutch, described and illustrated in January MACHINERY, page 373, which is mounted in the head itself, with an auxiliary clutch on the angle spindle; and a new single adjustable clutch of the impact type, mounted in the casing. With the latter type, the final drive is built into the angle driving spindle to obtain minimum clearances.

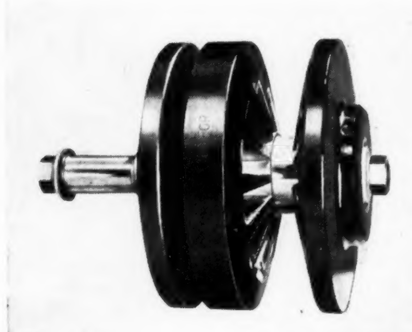


Rotor Right-angle Drilling and Nut-setting Tools

The tools are available in both short and long lengths, and can be equipped with a large variety of spindles for quick-change and snap-on driving sockets. 84

"Speedmaster" Variable-Speed Drive

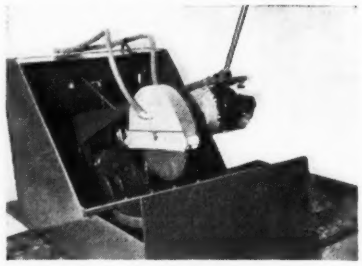
The Continental Machine Specialties, Inc., 1301-5 S. Washington Ave., Minneapolis, Minn., have developed an improved design of their "Speedmaster" variable-speed pulleys. These new pulleys are molded of solid, high impact strength Bakelite, and are accurately trued and balanced before final assembling. An improved pressure-lubricated bronze sleeve is employed to allow the splined center sheave member to operate freely, regardless of the load or speed. These pulleys are available in two sizes—a 3 1/2-inch diameter size for drives up to 1/2 H.P. capacity, and a 6 1/2-inch diameter size for drives up to 3 H.P. capacity. They are adapted for both "straight line" and "angular" drives.



"Speedmaster" Variable-speed Pulley

When interposed between the motor and the driven unit, the position of the pulley can be changed to vary the center distances of the Speedmaster pulley in relation to the driving and driven sheaves. The belts thus assume smaller or larger pitch-diameter operating positions through the action of the variable pulley faces. The speed is controlled through a quick-acting lever or a handwheel to within 1 R.P.M.

The advantages claimed for the improved Speedmaster include a 6-to-1 up to 40-to-1 ratio of infinitely variable speed; the use of standard V-belts; and long belt and pulley life because of the molded plastic pulley faces. 85



Portman Cut-off Machine with Automatic Control of Coolant

Portman Abrasive Cut-Off Machine

The Portman Machine Co., 2236-A Bathgate Ave., New York City, has placed on the market a new wet-cutting bench model abrasive cut-off machine. An outstanding feature of this machine is the automatic control of the coolant through a valve which operates in conjunction with the abrasive-wheel motor-arm to turn the coolant on and off for each cut.

This machine is designed for straight cutting only, using abrasive disks either 12 or 16 inches in diameter. Totally enclosed motors of a new design, with glass insulation, and having an offset spindle shaft as part of the direct motor drive, are employed. The abrasive-wheel spindle is mounted on duplex type preloaded bearings.

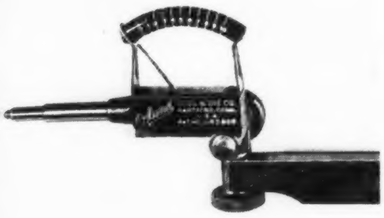
The machine is available with either 2- or 5-H.P. motors for operating the spindle at 2300 R.P.M. It has a capacity for cutting solid bars up to 2 1/2 inches and tubing, structural forms, moldings, etc., up to 3 3/4 inches. 86

Balancing Ways for Motor Armatures

A compact static balancing unit for motor armatures, built by the Ideal Commutator Dresser Co., 1011 Park Ave., Sycamore, Ill., is available in three sizes—10-inch swing, 300-pound capacity; 20-inch swing, 1000-pound capacity; and 42-inch swing, 1000-pound capacity. These units are made in different shaft lengths.

No leveling or setting up is necessary, the unit being ready for use as soon as it is placed on the floor or bench. No centers are required for balancing, the armature being carried on free-turning disks mounted on precision ball bearings. The standards that support the revolving disks are adjustable for any size armature within the limits of the unit. 87

To obtain additional information on equipment described on this page, see lower part of page 430.



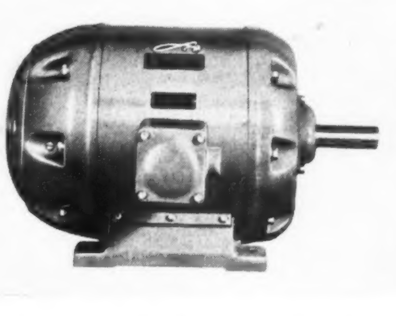
Oslund Universal Indicator

Oslund Universal Indicator

A universal shockproof indicator, with a 360-degree reading face designed to permit reading in any position, has been placed on the market by the Oslund Tool & Die Co., 1060 Broad St., Newark, N. J. This indicator is especially adapted for use in connection with jig boring and milling machine operations. Readings can be made without mirrors when the indicator is used upside down or facing toward the back of the machine. This indicator is so designed that it will not be damaged if the contact point is accidentally pushed beyond the maximum travel range of the pointer. 88

Louis Allis Streamline Motors

A new line of both alternating- and direct-current, explosion-proof, streamline electric motors, designed for dependability, convenience, long life and safety, has been placed on the market by the Louis Allis Co., Milwaukee, Wis. Eighteen major mechanical and electrical improvements, several of which are patented, have been incorporated in the new line. These motors have been developed for use in plants handling such explosive materials as oils, gasoline, chemicals, lacquer, paints, etc. 89



Streamline Explosion-proof Motor

A Popular Fallacy—The Man Over Forty

In several instances in the past, we have had occasion to call attention to the fact that in some of our largest industries an appreciable proportion of the employes are men over forty—many considerably over forty—despite the widely circulated idea that there are few men of this age in industry. Recently, the Westinghouse company placed on record, through its chairman of the board, A. W. Robertson, some figures relating to the number of people employed by that company who have definitely reached middle age. He mentioned that the Westinghouse company at the present time employs 12,410 people over forty-five, or 31 per cent of the total payroll. This is a higher percentage of men and women over forty-five than the average of the number of people in this age class in the general population; while Westinghouse employs 31 per cent of people over forty-five, the number of all people over forty-five of the population constitutes only 23 per cent of the total.

"It is true," said Mr. Robertson, "that the man of advanced years, out of work, does have a difficult time securing employment; but so, for that matter, does anyone out of work." We believe the recent depression has proved this fact to younger men as well as older.

Calling attention to another fact, Mr. Robertson said: "We should not lose sight of the fact that men of advanced years with jobs hold them when younger men lose theirs. In other words, during times of depression, older employes are preferred and continued on the payroll. The average organization has a larger percentage of people over forty-five than will be found in an average cross-section of the population."

Another point emphasized by Mr. Robertson was this: Younger men frequently find it easier to secure a job because they are willing to take anything that comes along. The persistence and willingness to do this, which is usually a characteristic of the younger person, would often bring results in the case of an older man as well. The trouble is that older men usually get the notion that they can do only one thing well, and that thing is what they want to do. It often happens that industry is well supplied with people doing the same kind of work as someone that may be unemployed. The older man must be willing to start at something else. If he is, he usually will find his opportunity.

"Of one thing we may be certain," said Mr. Robertson, "industry is not hostile to the older man, assuming that he is willing and well. He is usually more steady, careful, and reliable, has as good health as the younger man, or better, and is generally an entirely desirable type of employe."

The whole problem of unemployment is usually laid at industry's door, which is unfair. Even in the best of times only about one-half of the grown up self-supporting population is engaged in business and industry of every description. Manufacturing actually engages in good times considerably less than 25 per cent of the working population, so it can hardly be responsible for the unemployment throughout the entire country.

"This does not change the fact, however," said Mr. Robertson, "that men out of work are a problem which should cause everyone concern; and industry is concerned. Its employes are its first concern because it knows that it has no life or existence except through them. It values them above its customers, and delays posting the notice that there is no work as long as possible. It pays wages long after dividends have been discontinued. Well ordered industry started pensions and unemployment benefits long before Government ever thought of such a thing."

* * *

Brooklyn Dedicates Unusual Vocational School

The City of New York has recently opened a vocational school in Brooklyn known as the Brooklyn High School of Automotive Trades. The new school will accommodate 1600 students in twenty-six class-rooms and as many shops. The building has a frontage of 400 feet and a depth of 250 feet. It is four stories high, and contains approximately ten acres of floor space. Including the site, the building cost nearly $2,500,000, while the equipment of cars and machinery added over $500,000 to the expense. It is one of the few vocational schools in the country devoted exclusively to instruction in the automotive trades.

The attention given to vocational training is one of the encouraging signs of the times. Much of the unemployment today is due to lack of training for any specific work, and could be remedied by proper training.

To obtain additional information on equipment described on this page, see lower part of page 430.

Calculating Pulley Sizes for Shafts with Known Center Distances

By PAUL L. FOX

There are many instances in machine design when it is necessary or desirable to establish the center distance of a pair of shafts first, and to fit the required pulleys to them afterward. One such problem is met with in pulley design for V-belts, where it is necessary to find, for each step of the pulley, the diameters of a pair of steps with a definite speed ratio to fit a given belt length and a fixed center distance.

We start with the well-known formula:

$$L = 2C + \frac{\pi}{2}(D + d) + \frac{(D - d)^2}{4C}$$

in which

L = belt length at neutral axis;
C = center distance between shafts;
D = pitch diameter of larger pulley; and
d = pitch diameter of smaller pulley.

Let R = speed ratio = $\frac{D}{d}$.

By substituting Rd for D, and rearranging the formula, we obtain:

$$d = \frac{2(L - 2C)}{(R + 1)\pi} - \frac{(R - 1)^2}{2\pi C(R + 1)} d^2$$

Assume, for example, that $L = 61.12$; $R = 3.35$; and $C = 18.8$. Substituting these values in the formula, we obtain:

$$d = 3.441 - 0.01077d^2$$

In all problems for which the formula is sufficiently accurate, the term $\frac{(R - 1)^2}{2\pi C(R + 1)} d^2$ will be a relatively small quantity. This fact makes possible an easy solution, as follows:

If we neglect this second term, we have in our specific example, $d = 3.441$. Now, substituting this value of d in the second term,

$$d = 3.441 - 0.01077 \times 3.441^2 = 3.441 - 0.128 = 3.313$$

Repeat the substitution by using 3.313 for d; then

$$d = 3.441 - 0.01077 \times 3.313^2 = 3.323$$

Again repeating the substitution by using 3.323 for d,

$$d = 3.441 - 0.01077 \times 3.323^2 = 3.322$$

From this we obtain

$$D = 3.35 \times 3.322 = 11.128$$

The values of $0.01077d^2$ can be quickly obtained on the slide-rule to the required accuracy, which makes the work of repeated substitution very easy. The same is true of the coefficient of d^2, namely

$$\frac{(R - 1)^2}{2\pi C(R + 1)}$$

This leaves as the main item of computation the comparatively simple term $\frac{2(L - 2C)}{(R + 1)\pi}$.

* * *

The Investment in Dies is a Large Item in Automobile Manufacture

To produce a set of the huge dies employed in drawing the steel roof of a modern closed car requires 12,000 man-hours of work, much of it highly skilled. This is equivalent to one man working forty hours a week for six years, or approximately, to fifty men working for a period of six weeks. The work represents a combination of the most accurate craftsmanship and the use of the most highly developed automatic die-sinking machinery. The dies are first shaped accurately by machinery, by reproducing a full-scale mahogany model, and are then finished by the most exacting hand operations.

Yet the cost of the dies is not the main item in the cost of the equipment required for drawing these steel roofs. The huge presses in which the dies are used represent an enormous investment, justified only by large-scale manufacture. Nevertheless, because the investment is spread over tens of thousands of units, steel tops are now being provided on automobiles without increasing the cost of the car to the buyer.

In one of the body plants, ninety steel tops an hour are pressed out in a single press, producing a perfect top from a sheet of specially fabricated steel stretched and shaped by a total pressure of 3,000,000 pounds.

* * *

Research on Machinability

At the meeting of the Machine Shop Practice Division of the Metropolitan Section of the American Society of Mechanical Engineers, held in New York, January 5, Y. J. Bruce, metallurgical engineer of the Jones & Laughlin Steel Corporation, Pittsburgh, Pa., read a paper entitled "Some Aspects of the Mechanics of Machining." In this paper, Mr. Bruce discussed some research work done with the aid of a high-speed motion picture camera in observing the action of lathe tools cutting steel bars. The object of the research was to study the causes of the variations in the machinability of metals of different compositions. Motion pictures of chip formation, under various conditions of tool shape and material being cut, were shown.

* * *

According to the Bureau of Research and Education of the Advertising Federation of America, there are 700 broadcasting stations in the United States, and 80 per cent of all families own radios.

American Engineers to Visit the Leipzig Fair and German Industrial Plants

The Leipzig Fair, Inc., 10 E. 40th St., New York City, and the Association of German Machine Manufacturers are jointly organizing a five weeks' trip to Germany for American engineers. The program includes a three days' stay at the Leipzig Engineering Fair (which begins March 5) and subsequent visits to a large number of important German industrial plants, both in the machine tool and in the general machine-building field.

Among the machine tool plants that have invited American and Canadian engineers to visit them are such well-known firms as Herbert Lindner, Loewe-Gesfuerel, Wanderer, Alfred H. Schuette, and Pittler. The visits to general machine-building plants include the Humboldt-Deutz Diesel Engine Works, large Diesel engine works in Nuernberg and Augsburg, the Siemens-Schuckert Works in Berlin, as well as sections of the Krupp Steel Works. Other plants to be visited manufacture printing presses, woodworking machinery, and pumps.

The group will sail from New York for Hamburg on the S. S. *Hansa*, the evening of February 22, and will return to New York March 31. The return trip will start at Cherbourg, a day being spent in Paris previous to sailing.

The Leipzig Engineering Exhibition grounds, shown in the accompanying illustration, extend over approximately 100 acres, of which 35 acres are covered by a score of exhibition buildings, each housing the exhibits of one or more industries. The numbers on the illustration designate the buildings used for various classes of exhibits as follows: 1. Industrial plant accessories, equipment, and supplies. 2. Industrial equipment for the tropics. 3. Inventions and patents. 4. Radio, telephone, and kindred industries. 5. Miscellaneous industrial exhibits. 6. Office machinery, typewriters, etc. 7. Machines and equipment for chemical and food industries; household machinery; transportation equipment. 8. Textile machinery. 9. Machine tools. 10. Electrical machines and equipment. 11. Woodworking machinery and welding equipment. 12. Photography, motion pictures, and optical equipment; bicycles and motorcycles; engineering office and drafting-room equipment. 14. Machine tools and small tools. 18. Sewing machines. 19. Building machinery, equipment, and materials. (In the open space adjoining this building are outdoor exhibits of excavating and road-building machines.) 20. Industrial materials. 21 and 21a. Fuels; power plant equipment; heating and ventilating equipment. There is also an adjoining building for methods and equipment used in steel construction, and several outdoor exhibits of contractor's and similar equipment.

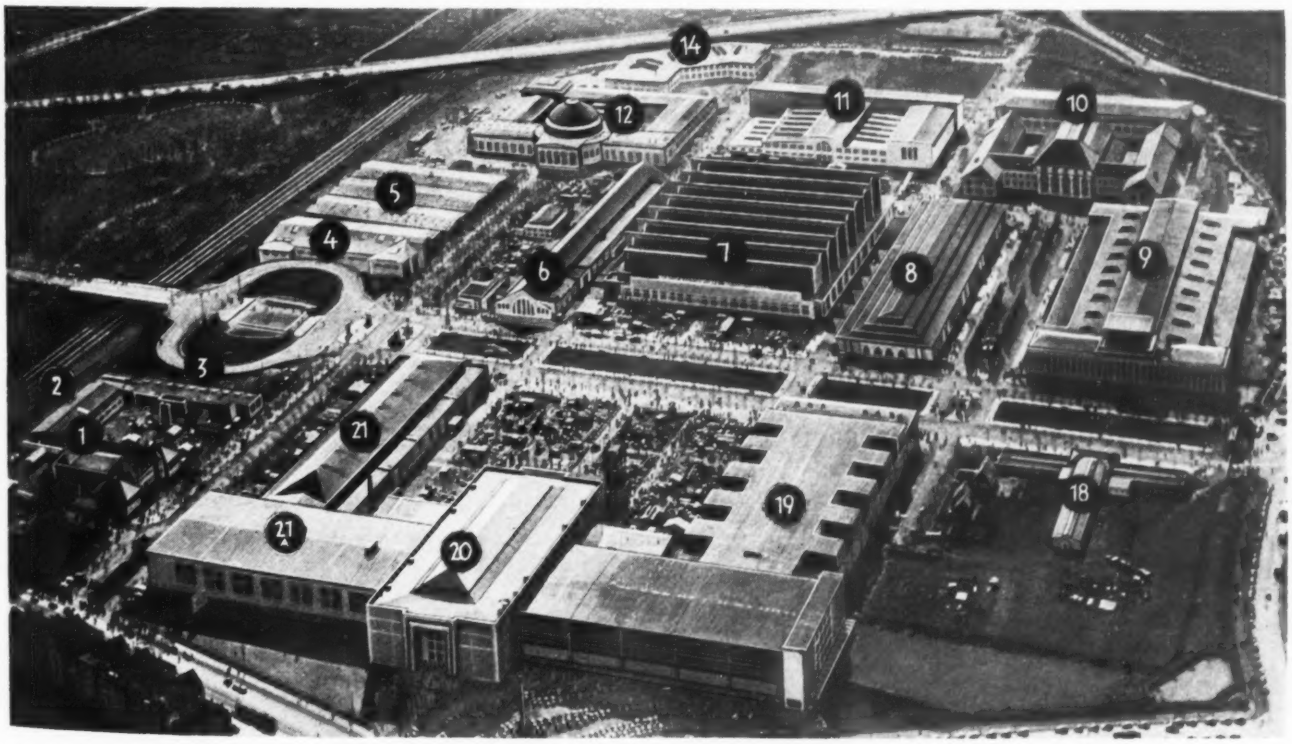
* * *

Editor of "Machinery" to Visit Leipzig Fair

In order to be able to report to the readers of MACHINERY and to the American machinery industries in general the trends in European machine tool building and machine shop practice, Erik Oberg, Editor of MACHINERY, will visit the Leipzig Engineering Fair in March, the same as last year. Besides studying recent developments in machine tool design at the Fair, Mr. Oberg plans to visit a number of machine-building plants in England.

* * *

One hundred and fifty typical companies in the United States paid in taxes during 1937, an amount that exceeded by 34 per cent the dividends paid to the common stockholders. In other words, the Government takes $4 for every $3 paid to the people who, through their savings, have made possible the building of the plants, the buying of the machinery, and the employment of workers.



Exhibition Buildings of the Leipzig Engineering Fair

Reporting a Company's Financial Operations to the Employes

Possibly one of the main reasons for misunderstanding among employes of industrial corporations is due to the fact that the employes are seldom taken into the confidence of the management. Most of the information they have relating to the affairs of the company is likely to come from sources that are not well informed or that, as is true of many agitators, wilfully misrepresent the facts. For this reason, the departure made by Revere Copper and Brass, Inc., is of particular interest.

This corporation has inaugurated a series of letters that are part of what is known as the "Know Your Company" program. These letters are distributed to all employes in the Revere organization. One of them contains a financial statement that is a model of clarity and simplicity. In fact, many stockholders would be glad to receive from their company's auditors a statement of the company's affairs expressed in such simple and direct terms. This statement is reproduced here; it covers the company's operations from January 1 to June 30, 1938.

One of the items that should be of considerable interest to the workers in the plant is the fact that the government tax collectors took over $325,000 of the company's earnings, *in spite of the fact that the operation of the company produced no profits, but a huge loss.* The stockholders' loss was equal to about one-half of the amount paid out in salaries and wages. In other words, the work of the management and the employes actually produced a net income of only one-half of what was paid out to them in salaries and wages; the other half of the salaries and wages came out of the stockholders' pockets, a very different story from that ordinarily told.

An Easily Understood Financial Statement

	Dollars	Per Cent
INCOME		
1. We billed our customers for products purchased from us	12,136,718.44	
2. From which we had to deduct for bad debts	14,820.50	
3. Leaving a net return from sales of	12,121,897.94	
4. We received interest, rents, and income from other sources amounting to	55,108.71	
5. Which gave us a total income to work with of	12,177,006.65	100.00
DISBURSEMENTS		
6. We paid others for materials (metals only)	6,857,176.46	56.31
7. And for fuel, transportation, supplies, and other costs and expenses	2,309,840.07	18.97
8. We set aside to replace wearing out plant and equipment	670,391.66	5.51
9. And paid interest for borrowed money	229,514.28	1.88
10. While government tax collectors required	327,875.86	2.69
11. This left for employes, management and stockholders	1,782,208.32	14.64
12. Our employes and management received in salaries and wages	3,601,917.82	
13. Leaving to stockholders a loss of	1,819,709.50	

A 190,000-pound Flywheel being Machined in East Pittsburgh Works of the Westinghouse Electric & Mfg. Co. This Flywheel is Used on a Blooming Mill in a Steel Plant